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NTC ORLANDO
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INTERIM REMEDIAL ACTION FOCUSED FIELD INVESTIGATION WORK PLAN OPERABLE
UNIT 4 (OU4) NTC ORLANDO FL
4/1/1996
ABB ENVIRONMENTAL SERVICES, INC

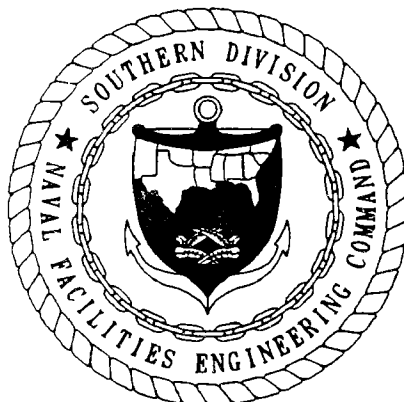


**INTERIM REMEDIAL ACTION
FOCUSED FIELD INVESTIGATION WORKPLAN
OPERABLE UNIT 4**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**

**UNIT IDENTIFICATION CODE: N65928
CONTRACT NO.: N62467-89-D-0317/107**

APRIL 1996



**SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010**

BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/2/96

SAMPLE ID	U4Y00101F	U4R00101F	U4R00201F	POTABLEH20	U4W00101F	53P00307F	53P00301F	
1/%Solids	1	1	1	1	1	1.23	1.15	
DF	1	1	1	1	1	1	1	
Vinyl Chloride	0.1	0.1	0.1	0.1	U	0.1	U	
1,1-Dichloroethene	0.7	0.6	0.4	1.0	U	1.0	U	
t-1,2-Dichloroethene	0.5	U	0.5	U	0.5	U	0.6	U
c-1,2-Dichloroethene	2.0	U	2.0	U	2.0	U	2.5	U
Trichloroethene	0.5	U	0.5	U	0.5	U	0.6	U
Tetrachloroethene	0.5	U	0.5	U	0.5	U	0.6	U
Benzene	0.5	U	0.5	U	0.5	U	0.6	U
Toluene	0.5	U	0.5	U	0.5	U	0.6	U
Ethylbenzene	0.5	U	0.5	U	0.5	U	0.6	U
m/p-Xylene	0.5	U	0.5	U	0.5	U	0.6	U
o-Xylene	0.5	U	0.5	U	0.5	U	0.6	U

Note -concentrations are in ppb, dry weight

-U qualifier is added when result is less than reporting limit

-J qualifier is added when result is estimated

-S qualifier is added for surrogate outside of accepted limits

-B qualifier is added for blank contamination

BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/3/96

SAMPLE ID	53P00302F		U4Y00201F		53P00303F		53P00304F		53P00305F		53P00306F		53P00308F		53P00309F		53P00310F	
1/%Solids	1.25		1		1.19		1.23		1.25		1.21		1.3		1.39		1.59	
DF	1		1		1		1		1		1		1		1		1	
Vinyl Chloride	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.2	U
1,1-Dichloroethene	1.3	U	1.0		1.2	U	1.2	U	1.3	U	1.2	U	1.3	U	1.4	U	1.6	U
t-1,2-Dichloroethene	0.6	U	0.5	U	0.6	U	0.6	U	0.6	U	0.6	U	0.7	U	0.7	U	0.8	U
c-1,2-Dichloroethene	2.5	U	2.0	U	2.4	U	2.5	U	2.5	U	2.4	U	2.6	U	2.8	U	3.2	U
Trichloroethene	0.6	U	0.5	U	0.6	U	0.6	U	0.6	U	0.6	U	0.7	U	0.7	U	0.8	U
Tetrachloroethene	0.6	U	0.5	U	0.6	U	0.6	U	0.6	U	0.6	U	0.7	U	0.7	U	0.8	U
Benzene	0.6	U	0.5	U	0.6	U	0.6	U	0.6	U	0.6	U	0.7	U	0.7	U	0.8	U
Toluene	0.6	U	0.5	U	0.6	U	0.6	U	0.6	U	0.6	U	0.7	U	0.7	U	0.8	U
Ethylbenzene	0.6	U	0.5	U	0.6	U	0.6	U	0.6	U	0.6	U	0.7	U	0.7	U	0.8	U
m/p-Xylene	0.6	U	0.5	U	0.6	U	0.6	U	0.6	U	0.6	U	0.7	U	0.7	U	0.8	U
o-Xylene	0.6	U	0.5	U	0.6	U	0.6	U	0.6	U	0.6	U	0.7	U	0.7	U	0.8	U

Note -concentrations are in ppb, dry weight

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BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/3/96

SAMPLE ID	U4D00101F		ZSPRINGF		CSPRINGF	
1/%Solids	1.38		1		1	
DF	1		1		1	
Vinyl Chloride	0.1	U	0.1	U	0.1	US
1,1-Dichloroethene	1.4	U	1.0	U	1.0	US
t-1,2-Dichloroethene	0.7	U	0.5	U	0.5	US
c-1,2-Dichloroethene	2.8	U	2.0	U	2.0	US
Trichloroethene	0.7	U	0.5	U	0.5	US
Tetrachloroethene	0.7	U	0.5	U	0.5	US
Benzene	0.7	U	0.5	U	0.5	US
Toluene	0.7	U	0.5	U	0.5	US
Ethylbenzene	0.7	U	0.5	U	0.5	US
m/p-Xylene	0.7	U	0.5	U	0.5	US
o-Xylene	0.7	U	0.5	U	0.5	US

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BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/6/96

SAMPLE ID

U4Y00301F

1/%Solids	1	
DF	1	
Vinyl Chloride	0.1	U
1,1-Dichloroethene	1.0	U
t-1,2-Dichloroethene	0.5	U
c-1,2-Dichloroethene	2.0	U
Trichloroethene	0.5	U
Tetrachloroethene	0.5	U
Benzene	0.5	U
Toluene	0.5	U
Ethylbenzene	0.5	U
m/p-Xylene	0.5	U
o-Xylene	0.5	U

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BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/7/96

SAMPLE ID	U4Y00401F	U4R00401F	U4W00201F	U4Y00501F	U4W00301F	U4D00201F	TB0002F	U4W00601F	U4D00601F
1/%Solids	1	1	1	1	1	1.23	1	1	8.55
DF	1	1	1	1	1	1	1	1	1
Vinyl Chloride	0.13	0.12	12	0.2	62 E	0.4	0.1 U	65 E	95
1,1-Dichloroethene	0.7	0.6	1.1	1.0 U	1.1	1.2 U	1.0 U	1.0 U	8.6 U
t-1,2-Dichloroethene	0.5 U	0.5 U	13	0.5 U	10	2.1	0.5 U	0.7	5.6
c-1,2-Dichloroethene	2.0 U	2.0 U	230 E	2.0 U	180 E	110 E	2.0 U	100 E	750 E
Trichloroethene	0.5 U	0.5 U	150 E	0.5 U	76 E	220 E	0.5 U	23	27
Tetrachloroethene	0.5 U	0.5 U	63 E	0.5 U	0.5 U	92 E	0.5 U	0.5 U	4.3 U
Benzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.6 U	0.5 U	0.5 U	4.3 U
Toluene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.6 U	0.5 U	0.5 U	4.3 U
Ethylbenzene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.6 U	0.5 U	0.5 U	4.3 U
m/p-Xylene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.6 U	0.5 U	0.5 U	4.3 U
o-Xylene	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.6 U	0.5 U	0.5 U	4.3 U

Note -concentrations are in ppb, dry weight

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BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/8/96

SAMPLE ID

U4D00301F

1/%Solids	1.22	
DF	1	
Vinyl Chloride	0.1	U
1,1-Dichloroethene	1.2	U
t-1,2-Dichloroethene	1.0	
c-1,2-Dichloroethene	92	E
Trichloroethene	150	E
Tetrachloroethene	1.6	
Benzene	0.6	U
Toluene	0.6	U
Ethylbenzene	0.6	U
m/p-Xylene	0.6	U
o-Xylene	0.6	U

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BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/8/96

SAMPLE ID	U4D00502F		U4D00501F		U4D00402F		U4D00401F		U4R00501F		U4W00701F		U4W00801F		U4D00701F		U4D00702F	
1/%Solids	1.20		1.35		1.22		1.60		1		1		1		1		1.22	
DF	1		1		1		1		1		1		1		1		1	
Vinyl Chloride	0.1	U	0.1	US	0.1	U	0.2	US	0.1	U	0.1	U	0.1	U	0.1	US	0.1	U
1,1-Dichloroethene	1.2	U	1.4	US	1.2	U	1.6	US	1.0	U	1.0	U	1.0	U	1.0	US	1.2	U
t-1,2-Dichloroethene	0.6	U	0.7	US	0.6	U	0.8	US	0.5	U	0.5	U	0.5	U	0.5	US	0.6	U
c-1,2-Dichloroethene	2.4	U	2.7	US	2.4	U	3.2	US	2.0	U	2.0	U	2.0	U	2.0	US	2.4	U
Trichloroethene	0.6	U	0.7	US	0.6	U	0.8	US	0.5	U	0.5	U	0.5	U	0.5	US	3.7	
Tetrachloroethene	0.6	U	0.7	US	0.6	U	0.8	US	0.5	U	0.5	U	0.5	U	0.5	US	0.6	U
Benzene	0.6	U	0.7	US	0.6	U	0.8	US	0.5	U	0.5	U	0.5	U	0.5	US	0.6	U
Toluene	0.6	U	0.7	US	0.6	U	0.8	US	0.5	U	0.6		0.5	U	11	US	0.6	U
Ethylbenzene	0.6	U	0.7	US	0.6	U	0.8	US	0.5	U	0.5	U	0.5	U	0.5	US	0.6	U
m/p-Xylene	0.6	U	0.7	US	0.6	U	0.8	US	0.5	U	0.5	U	0.5	U	0.5	US	0.6	U
o-Xylene	0.6	U	0.7	US	0.6	U	0.8	US	0.5	U	0.5	U	0.5	U	0.5	US	0.6	U

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BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/8/96

SAMPLE ID	U4D00801F		U4D00802F		U4W00901F		U4W00901FD		U4W01001F		U4W01001F 1:10		U4W01101F		U4D00901F		U4D00901FD	
1/%Solids	3.45		1.25		1		1		1		1		1		1.35		1.40	
DF	1		1		1		1		1		1		1		1		1	
Vinyl Chloride	0.3	US	0.1	U	0.5		0.6		150	E	280		12		0.1	U	0.1	U
1,1-Dichloroethene	3.5	US	1.3	U	1.0	U	1.0	U	6.4		1.0	U	1.0		1.4	U	1.4	U
t-1,2-Dichloroethene	1.7	US	0.6	U	0.5	U	0.5	U	46		35		1.2		0.7	U	0.7	U
c-1,2-Dichloroethene	6.9	US	2.5	U	2.3		2.3		310	E	1200	E	94	E	2.2		2.8	U
Trichloroethene	1.7	US	1.1		0.5	U	0.5	U	240	E	920	E	25		0.7	U	0.6	
Tetrachloroethene	1.7	US	0.6	U	0.5	U	0.5	U	79	E	150		0.5	U	0.7	U	0.7	U
Benzene	1.7	US	0.6	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.7	U	0.7	U
Toluene	1.7	US	0.6	U	0.5	U	0.5	U	0.5		0.5	U	1.0		1.6		0.7	U
Ethylbenzene	1.7	US	0.6	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.7	U	0.7	U
m/p-Xylene	1.7	US	0.6	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.7	U	0.7	U
o-Xylene	1.7	US	0.6	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.7	U	0.7	U

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BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/8/96

SAMPLE ID	U4D01101F	U4D01102F	U4D01001F	U4D01001FR
1/%Solids	1.73	1.21	3.97	3.97
DF	1	1	1	1250
Vinyl Chloride	1.3	0.1 U	13	500 U
1,1-Dichloroethene	1.7 U	1.2 U	4.0 U	5000 U
t-1,2-Dichloroethene	0.9 U	0.6 U	35	2500 U
c-1,2-Dichloroethene	38	22	500 E	9900 U
Trichloroethene	3.6	3.8	1900 E	53,000
Tetrachloroethene	0.9 U	0.6 U	1900 E	94,000
Benzene	0.9 U	0.6 U	2.0 U	2500 U
Toluene	0.9 U	0.6 U	3.3	2500 U
Ethylbenzene	0.9 U	0.6 U	2.0 U	2500 U
m/p-Xylene	0.9 U	0.6 U	2.0 U	2500 U
o-Xylene	1.3	10	1.9	2500 U

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BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/9/96

SAMPLE ID	U4T00301F		U4R00601F		U4W01201F		U4W01301F		U4D01201F		U4D01301F		U4D01302F		U4W01601F		U4W01401F	
1/%Solids	1		1		1		1		4.26		2.36		1.33		1		1	
DF	1		1		1		1		1		1		1		1		1	
Vinyl Chloride	0.1	U	0.1	U	83		23		53	S	0.2	US	0.1	U	0.1	U	5.8	
1,1-Dichloroethene	1.0	U	1.0	U	0.9		1.0	U	4.3	US	2.4	US	1.3	U	1.0	U	1.0	U
t-1,2-Dichloroethene	0.5	U	0.5	U	0.7		6.8		28	S	6.8	S	1.7		0.5	U	0.5	U
c-1,2-Dichloroethene	2.0	U	2.0	U	180		500	E	3000	ES	700	ES	220		2.0	U	42	
Trichloroethene	0.5	U	0.5	U	5.6		97		1400	ES	360	S	79		5.1		33	
Tetrachloroethene	0.5	U	0.5	U	0.5	U	0.6		43	S	22	S	0.9		1.6		2.8	
Benzene	0.5	U	0.5	U	0.5	U	0.5	U	2.1	US	1.2	US	0.7	U	0.5	U	0.5	U
Toluene	0.5	U	0.5	U	7.2		0.5	U	2.3	S	1.2	US	0.7	U	0.5	U	0.5	U
Ethylbenzene	0.5	U	0.5	U	0.5	U	0.5	U	2.1	US	1.2	US	0.7	U	0.5	U	0.5	U
m/p-Xylene	0.5	U	0.5	U	0.5	U	0.5	U	2.1	US	1.2	US	0.7	U	0.5	U	0.5	U
o-Xylene	0.5	U	0.5	U	0.5	U	0.5	U	2.1	US	1.2	US	0.7	U	0.5	U	0.5	U

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Harlan F. III

BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/10/96

SAMPLE ID	U4T00401F		U4R00801F		U4T00501F		U4R00701F		U4W01501F		U4D01501F		U4D01502F		U4D01601F		U4D01602F	
1/%Solids	1		1		1		1		1		1.95		1.26		1.66		1	
DF	1		1		1		1		1		1		1		1		1	
Vinyl Chloride	0.1	U	0.1	U	0.1	U	0.1	U	0.6		0.2	U	0.1	U	0.2	U	0.1	U
1,1-Dichloroethene	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	2.0	U	1.3	U	1.7	U	1.0	U
t-1,2-Dichloroethene	0.5	UJ	0.5	UJ	0.5	UJ	0.5	UJ	0.7	J	1.0	UJ	0.6	UJ	0.8	UJ	0.5	UJ
c-1,2-Dichloroethene	2.0	U	2.0	U	2.0	U	2.0	U	74		38		10		3.3	U	2.0	U
Trichloroethene	0.5	U	0.5	U	0.5	U	0.5	U	26		56		13		0.7		0.5	U
Tetrachloroethene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	1.4		0.6	U	1.0		0.7	
Benzene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	1.0	U	0.6	U	0.8	U	0.5	U
Toluene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	1.4		0.6	U	0.8	U	0.5	U
Ethylbenzene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	1.0	U	0.6	U	0.8	U	0.5	U
m/p-Xylene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	1.0	U	0.6	U	0.8	U	0.5	U
o-Xylene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	1.0	U	0.6	U	0.8	U	0.5	U

Note -concentrations are in ppb, dry weight

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BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/10/96

SAMPLE ID	U4D01801F		U4D01802F		U4D01701F		U4D01702F		U4R00801F1		U4W01801F		U4W01701F		U4S00101F		U4S00201F	
1/%Solids	5.0		1.21		4.2		1.26		1		1		1		1.13		1.1	
DF	1		1		1		1		1		1		1		1		1	
Vinyl Chloride	0.5	US	0.2		0.5	S	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
1,1-Dichloroethene	5.0	US	1.2	U	4.2	US	1.3	U	1.0	U	1.0	U	1.0	U	1.1	U	1.1	U
t-1,2-Dichloroethene	2.5	USJ	0.6	UJ	2.1	USJ	0.6	UJ	0.5	UJ	0.5	UJ	0.5	UJ	0.6	UJ	0.6	UJ
c-1,2-Dichloroethene	7.9	S	2.4	U	8.4	US	2.5	U	2.0	U	2.0	U	2.0	U	2.3	U	2.2	U
Trichloroethene	10	S	1.3		2.1	US	0.6	U	0.5	U	0.5		0.9		0.6	U	0.6	U
Tetrachloroethene	20	S	0.6	U	2.1	US	0.6	U	0.5	U	0.5	U	0.5	U	0.6	U	0.6	U
Benzene	2.5	US	0.6	U	2.1	US	0.6	U	0.5	U	0.5	U	0.5	U	0.6	U	0.6	U
Toluene	550	S	0.6	U	150	S	0.6	U	0.5	U	17		6		0.6	U	0.6	U
Ethylbenzene	2.5	US	0.6	U	2.1	US	0.6	U	0.5	U	0.5	U	0.5	U	0.6	U	0.6	U
m/p-Xylene	2.5	US	0.6	U	2.1	US	0.6	U	0.5	U	0.5	U	0.5	U	0.6	U	0.6	U
o-Xylene	2.5	US	0.6	U	2.1	US	0.6	U	0.5	U	0.5	U	0.5	U	0.6	U	0.6	U

Note -concentrations are in ppb, dry weight

-U qualifier is added when result is less than reporting limit

-J qualifier is added when result is estimated

-S qualifier is added for surrogate outside of accepted limits

-B qualifier is added for blank contamination

BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/10/96

SAMPLE ID	U4S00301F		U4S00401F		U4D01402F		U4D01401F	
1/%Solids	1.82		1.95		1.26		2.52	
DF	1		1		1		1	
Vinyl Chloride	0.2	US	0.2	US	0.1	U	0.3	U
1,1-Dichloroethene	1.8	US	2.0	US	1.3	U	2.5	U
t-1,2-Dichloroethene	0.9	USJ	1.0	USJ	0.6	UJ	1.3	UJ
c-1,2-Dichloroethene	3.6	US	3.9	US	6.1		53	
Trichloroethene	0.9	US	1.0	US	7.8		72	
Tetrachloroethene	0.9	US	1.0	US	0.6	U	1.8	
Benzene	0.9	US	1.0	US	0.6	U	1.3	U
Toluene	0.9	US	1.0	US	0.6	U	1.3	U
Ethylbenzene	0.9	US	1.0	US	0.6	U	1.3	U
m/p-Xylene	0.9	US	1.0	US	0.6	U	1.3	U
o-Xylene	0.9	US	1.0	US	0.6	U	1.3	U

Note -concentrations are in ppb, dry weight

- U qualifier is added when result is less than reporting limit
- J qualifier is added when result is estimated
- S qualifier is added for surrogate outside of accepted limits
- B qualifier is added for blank contamination

BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/11/96

SAMPLE ID	U4R00901F		U4R01001F		U4R01011F		U4R01201F		U4W01801FD		U4W01901F		U4W02001F		U4W02101F		U4W02201F	
1/%Solids	1		1		1		1		1		1		1		1		1	
DF	1		1		1		1		1		1		1		1		1	
Vinyl Chloride	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	13		7.6		6.8		0.1	U
1,1-Dichloroethene	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
t-1,2-Dichloroethene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
c-1,2-Dichloroethene	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	34		15		29		6.1	
Trichloroethene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	3.7		2.1	
Tetrachloroethene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.6		0.9	
Benzene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
Toluene	0.5	U	0.5	U	0.5	U	0.5	U	30		0.5	U	0.5	U	0.5	U	0.5	U
Ethylbenzene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
m/p-Xylene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
o-Xylene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U

Note -concentrations are in ppb, dry weight

-U qualifier is added when result is less than reporting limit

-J qualifier is added when result is estimated

-S qualifier is added for surrogate outside of accepted limits

-B qualifier is added for blank contamination

BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/10/96

11

JP

JP

SAMPLE ID	U4T00701F		U4T00801F		U4Q00101F		U4Q00102F		U4W02301F		U4Q00103F		U4Q00104F		U4Q00105F		U4W02401F	
1/%Solids	1		1		1		1		1		1		1		1		1	
DF	1		1		1		1		1		10		10		10		1	
Vinyl Chloride	0.1	U	0.1	U	0.1	U	0.1	U	8.6		1.0	U	1.0	U	1.0	U	0.1	U
1,1-Dichloroethene	1.0	U	1.0	U	1.0		1.0	U	1.0	U	10	U	10	U	10.0	U	1.0	U
t-1,2-Dichloroethene	0.5	U	0.5	U	0.4		2.5		0.5	U	5.0	U	5.0	U	5.0	U	0.5	U
c-1,2-Dichloroethene	2.0	U	2.0	U	180		570	E	27		410		370		830		4.3	
Trichloroethene	0.5	U	0.5	U	270	E	950	E	0.5	U	110		93		110		2.0	
Tetrachloroethene	0.5	U	0.5	U	1.6		71		0.5	U	5.0	U	5.0	U	5.0	U	4.7	
Benzene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	5.0	U	5.0	U	5.0	U	0.5	U
Toluene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	5.0	U	5.0	U	5.0	U	0.5	U
Ethylbenzene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	5.0	U	5.0	U	5.0	U	0.5	U
m/p-Xylene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	5.0	U	5.0	U	110		0.5	U
o-Xylene	0.5	U	0.5	U	0.5	U	0.5	U	0.5	U	5.0	U	5.0	U	16		0.5	U

Note -concentrations are in ppb, dry weight

-U qualifier is added when result is less than reporting limit

-J qualifier is added when result is estimated

-S qualifier is added for surrogate outside of accepted limits

-B qualifier is added for blank contamination

BRAC OU4 NTC ORLANDO,FL

Preliminary Data Table

5/10/96

11

SAMPLE ID	U4D01802FD		U4Q00101FR		U4Q00102FR		U4R01301F		U4R01401F	
1/%Solids	1.21		1		1		1		1	
DF	1		10		10		1		1	
Vinyl Chloride	0.1	U	1.0	U	1.0	U	0.1	U	0.1	U
1,1-Dichloroethene	1.2	U	10	U	10	U	1.0	U	1.0	U
t-1,2-Dichloroethene	0.6	U	5.0	U	5.0	U	0.5	U	0.5	U
c-1,2-Dichloroethene	2.4	U	230		540		2.0	U	2.0	U
Trichloroethene	1.2		420		990		0.5	U	0.5	U
Tetrachloroethene	0.8		5.0	U	75		0.5	U	0.5	U
Benzene	0.6	U	5.0	U	5.0	U	0.5	U	0.5	U
Toluene	0.6	U	5.0	U	5.0	U	0.5	U	0.5	U
Ethylbenzene	0.6	U	5.0	U	5.0	U	0.5	U	0.5	U
m/p-Xylene	0.6	U	5.0	U	5.0	U	0.5	U	0.5	U
o-Xylene	0.6	U	5.0	U	5.0	U	0.5	U	0.5	U

Note -concentrations are in ppb, dry weight

-U qualifier is added when result is less than reporting limit

-J qualifier is added when result is estimated

-S qualifier is added for surrogate outside of accepted limits

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PROJECT Information	TO: John Kulser	FROM: My <i>Final Lead</i>	DATE: 5/13/96
	FAX #:	FAX #:	PAGES INCLUDING THIS PAGE: 4
		PHONE #:	4
		CHG. DT	DATE 5-13-96

Page 1 of 4

- The concentrations within the surface water indicate that vinyl chloride with a saturation concentration in air (1% of PEL) at 25,000% can create a field exposure. If the % is > 5000, field exposure could be significant.
- This calculation is an estimation & ~~the estimated concentrations that~~ ^{the estimated} would be found at equilibrium conditions within a confined area. What were the b2 readings during this investigation?
- The data to rely on for the future investigations is the source and breathing zone monitoring that is currently taking place with the ~~breathing~~ Terra probe. Also, look at the b2 readings that occurred during the surface water collection. ~~The spreadsheet is less conservative~~
- Use the monitoring strategies that I had sent to Mark on 5-7-96.
- In our conversation on 5-13-96, you have indicated that the expected concentrations within the soil ~~and groundwater~~ will be TCE and PCE in the low ppm ranges.
- These ranges typically do not warrant respiratory protection. In groundwater, 10 ppm of PCE would warrant upgrading to Level C.
- The actions levels that are being used have the following safety factors built in:
 - action levels are set at 1/2 PEL
 - the PEL during site activities is being used as a ceiling limit vs. an 8 hr allowable exposure
 - assuming the FID is only reading the one contaminant, vinyl chloride.

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	CHK. BY	DATE

Pg. 2 of 4

- vinyl chloride draeger tube - It also monitors or can pick up the following halogenated compounds: PCE, TCE, DCE, chlorobenzene. These interferences will cause a ⊕ result, therefore resulting in an upgrade in level of protection.
- use source monitoring to evaluate what may be in the b.z.
- At other sites, usually vinyl chloride is not seen within the breathing zone. If found in high concentrations, level B is worn or B+K and fans are used to monitor the work area.
- ~~Summary~~ The PID can operate in the humidity range b/w 5-95% if the humidity is non-condensing. ~~Since~~ the humidity most of the time condenses to ~~the~~ ^{form} moisture or a vapor. The PIDs in the past have had problems in high humidity. The humidity will short the unit out. Therefore, it is recommended the PID be used to monitor for vinyl chloride on high humidity days.
- Summary:
Based on the information that has been presented for this site, start at ~~level D~~ modified level D. Relying on past b.z. and source readings, will be the first item to look at to determine if initial level of protection should be changed. If these readings have all been at background, then stay at modified level D. If not, or there is further doubts

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	CHK. BY	DATE

Page 3 of 4
Soil

about the concentrations within the soil and groundwater, then the only two other options are the following:

- 1) Monitor with the BTK, using Fans too.
- 2) Start at Level B.
(high physical hazard, due to heat stress)

If there is not a comfort level with the recommended monitoring (best available technology), then use one of the above options.

"WORST CASE" VAPOR EXPOSURE CALCULATION

for volatile compounds in water

Name of Site: NTC Orlando - Surface Water Samples

CONTAMINANT	Maximum Concentr'n (site water) (ug/l)	Water Solubility mg/l	Vapor Pressure When Pure (torr)	Exposure Limit (OSHA) (ppm)	Saturation Concentr'n in Air (ppm)	Fraction of Total vapor in Air (% by ppm)	Saturation Concentr'n in Air % of PEL	NAME OF CHEMICAL
Acetone	0.000000001	3000000	180	750	0.00	0.00%	0.00%	Acetone
Benzene	0.000000001	800	75	1	0.00	0.00%	0.00%	Benzene
Bromochloromethane	0.000000001	10000	300	200	0.00	0.00%	0.00%	Bromochloromethane
Carbon Disulfide	0.000000001	2000	300	4	0.00	0.00%	0.00%	Carbon Disulfide
Carbon Tetrachloride	0.000000001	800	91	2	0.00	0.00%	0.00%	Tetrachloromethane
Chlorobenzene	0.000000001	500	11.8	10	0.00	0.00%	0.00%	Chlorobenzene
Chloroform	0.000000001	7950	246	2	0.00	0.00%	0.00%	Trichloromethane
Dibromochloromethane	0.000000001	4700	50	1	0.00	0.00%	0.00%	Chlorodibromomethane
Dichlorobenzenes	0.000000001	156	1.47	75	0.00	0.00%	0.00%	Dichlorobenzene
1,1-Dichloroethane	0.000000001	5060	227	100	0.00	0.00%	0.00%	1,1-Dichloroethane
1,2-Dichloroethane	0.000000001	8524	90	1	0.00	0.00%	0.00%	1,2-Dichloroethane
1,1-Dichloroethene	0.000000001	2500	591	1	0.00	0.00%	0.00%	Vinylidene chloride
1,2-Dichloroethene	1200	800	200	200	394.80	53.94%	197.40%	1,2-Dichloroethene
1,4-Dioxane	0.000000001	2000000	30	25	0.00	0.00%	0.00%	1,4-Dioxane
Ethylbenzene	0.000000001	150	7.1	100	0.00	0.00%	0.00%	Ethyl Benzene
Ethyl Chloride	0.000000001	5740	900	1000	0.00	0.00%	0.00%	Ethyl Chloride
Methyl Butyl Ketone	0.000000001	5000000	3.8	5	0.00	0.00%	0.00%	Methyl Butyl Ketone
Methyl Chloride	0.000000001	4800	3756	50	0.00	0.00%	0.00%	Chloromethane
Methyl Ethyl Ketone	0.000000001	3560000	100	200	0.00	0.00%	0.00%	Methyl Ethyl Ketone
Methylene Chloride	0.000000001	13000	435	50	0.00	0.00%	0.00%	Dichloromethane
Naphthalene	0.000000001	31.7	0.082	10	0.00	0.00%	0.00%	Naphthalene
Propylene Dichloride	0.000000001	2600	40	75	0.00	0.00%	0.00%	Propene Dichloride
Styrene	0.000000001	300	7	50	0.00	0.00%	0.00%	Styrene
Tetrachloroethane	0.000000001	2900	7	1	0.00	0.00%	0.00%	Tetrachloroethane
Tetrachloroethylene	0.000000001	150.3	18.49	25	0.00	0.00%	0.00%	Tetrachloroethene
Toluene	0.000000001	500	25	50	0.00	0.00%	0.00%	Toluene
1,1,1-Trichloroethane	0.000000001	4400	124	350	0.00	0.00%	0.00%	Methyl Chloroform
1,1,2-Trichloroethane	0.000000001	4500	25	10	0.00	0.00%	0.00%	1,1,2-Trichloroethane
Trichloroethylene	920	1100	75	50	82.55	11.28%	165.10%	Trichloroethene
Vinyl Chloride	280	1100	760	1	254.59	34.78%	25458.62%	Vinyl Chloride
Xylene	0.000000001	130	6.6	100	0.00	0.00%	0.00%	Xylene

Combined Volatiles Level (ppm) = 731.94

100.00%

Percent Combined Exposure Limit = 25458.62%

Field exposure hazard. would warrant level B. However, rely more on past air monitoring data.

* Estimated Relative Response based on IP and similar compounds

To: Mark Haus
From: Meg MacLeod
Date: May 7, 1996
Subject: Action Levels

The following are options that can be used during the site investigation.

1. A Bruel & Kjaer Multi-gas monitor (B&K) has been used on sites where vinyl chloride is the contaminant of concern. This instrument would replace the use of the Draeger Tube. It is an instrument that can be calibrated to certain contaminants and can monitor the air down to the ppb ranges, similar to a GC. The rental of the instrument is expensive because a chemist is hired to perform the calibration on the instrument. If this instrument is used, the action level to upgrade to Level B will be if vinyl chloride or vinylidene concentrations are detected in the breathing zone at greater than or equal to 0.5 ppm concentrations. The action levels for the use of the FID would remain the same.

Attached is information on the instrument. I will leave a message on your voice mail tomorrow to give a name and number to contact for rental of the instrument.

2. Since safety factors are built into the action levels, heat stress is a major hazard, and the use of the Draeger tube is not for accuracy or accurate measurements, the Draeger tube can be used as an indicator if the vinyl chloride is present at the source. It is recognized the humidity and temperature even reduce the accuracy of the Draeger Tube even further.

The Draeger Tube can be used to monitor the source, i.e. (split spoons, at the bore hole, or head space of a sample) at intervals where sources of contamination may be encountered, i.e. (monitoring when there is a break in the drilling due to additional rods being added while the auger is being advanced, not to exceed 30 minutes). If there is any color change on the Draeger tube at the source, then any readings that are detected on the FID within the breathing zone that is above background can be assumed to be vinyl chloride. Therefore, an upgrade to Level B would be required.

If the FID has detects in the breathing zone without any detects with the Draeger tube that was used to monitor the source, then the action levels that are currently is the HASP for the FID can be used as the upgrade levels, i.e. (8 ppm, upgrade to Level C).

3. This statement is not an option, but a conclusion. If there is complete doubt on the use of the Draeger Tube, then upgrade to Level B would have to occur if there is any steady detect above background in the breathing zone on the FID.

SS Wilbur

Product Data

Multi-gas Monitor — Type 1302

USES:

- Quantitative analysis of up to 5 components and water vapour in gas mixtures
- Occupational health and safety measurements
- Indoor air-quality and ventilation measurements
- Detection of accidental releases of gases/vapours

FEATURES:

- Selectively detects a wide range of gases/vapours
- Linear response over a wide dynamic range
- Extremely reliable due to self-testing procedures
- High stability (low drift) makes calibration only necessary about four times a year
- User-friendly — easily operated by non-technical personnel

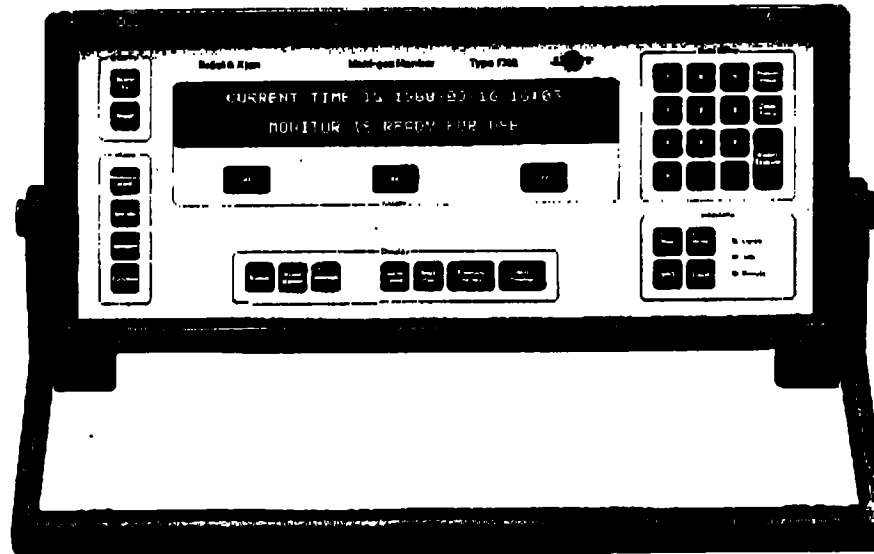
- Accurate — compensates for temperature fluctuations, water-vapour interference and interference from other known gases
- Extensive data-storage capacity
- Equipped with RS 232C serial and IEEE 488 parallel interfaces for data transfer/remote control
- Portable
- Operates immediately — no warm-up time necessary
- Immediate display of measurement results
- Collects samples from points up to 50m away
- Used with one/two Multipoint Doser and Sampler Units Type 1303 it can monitor air samples collected from 6/12 different locations

Introduction

The Brüel & Kjær Multi-gas Monitor Type 1302 is a highly accurate, reliable and stable quantitative gas analyzer which is microprocessor controlled. Its measurement principle is based on the photoacoustic infra-red detection method. In effect this means that the 1302 can be used to measure almost any gas which absorbs infra-red light. Appropriate optical filters (up to 5) are installed in the 1302's filter carousel so that it can selectively measure the concentration of up to 5 component gases and water vapour in any air sample. The 1302's detection threshold is gas-dependent but typically in the 10³ ppm region.

Reliability of measurement results is ensured by the regular self-tests which the 1302 performs to check that it is functioning correctly. Accuracy is ensured by the 1302's ability to compensate any measurement for temperature fluctuations, water-vapour interference and interference from other gases which are known to be present.

The Multi-gas Monitor is easily operated via its front-panel push-but-

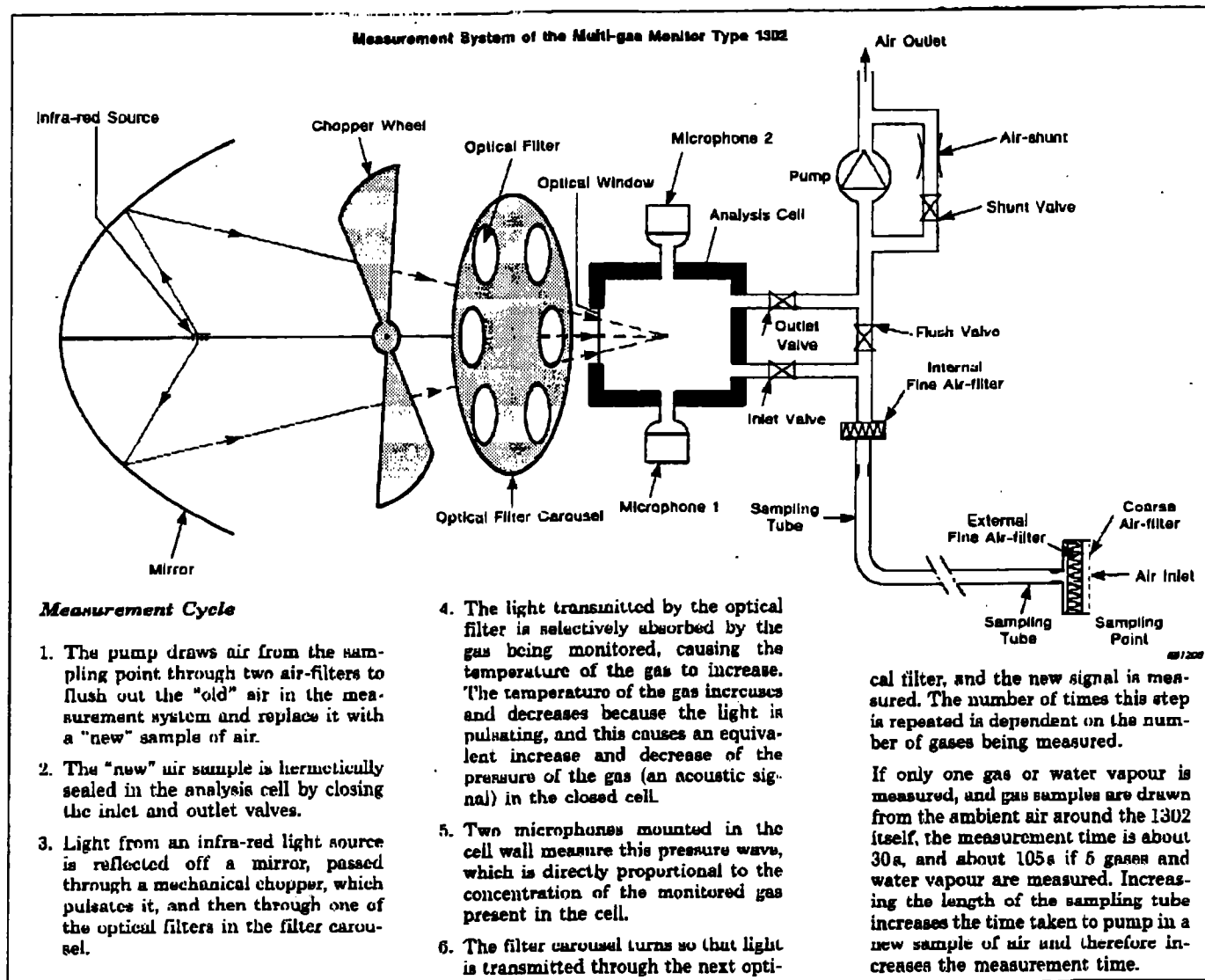


tons. Each time a push-button is pressed a short self-explanatory text appears on the 1302's display screen which guides the user through each operating procedure. Directions are so logical and uncomplicated that no special training is required to learn to operate the 1302.

Users can "set-up" the 1302 to perform almost any type of monitoring task. Measurement results are dis-

played on the 2×40 character display screen as soon as they are available (30s for one gas and 105s for 5 gases and water vapour). These results are automatically stored in the 1302's extensive memory and can be printed or plotted out at a later stage.

The measurement system and the electronics necessary for signal processing and data storage are enclosed in the dust-proof case of the 1302. Be-



ing portable and requiring no warm-up time or re-calibration after moving, the 1302 is ideal for short-term monitoring of air samples drawn from its immediate environment. For long term monitoring the 1302 is placed indoors and collects air samples for analysis, via polytetrafluoroethylene tubing, from points up to 50m away.

Selectivity

The selectivity of the Multi-gas Monitor is determined by the optical filters installed in the 1302's filter carousel. A wide range of narrow-band optical filters is available from Brüel & Kjær. By studying the absorption spectra of the gases to be monitored, as well as the absorption spectra of any other gases which are likely to be found in the ambient air in the same area, the most appropriate optical filters can be chosen. Please refer to the Product Data Sheet for the Optical Filters for details.

Water vapour, which is nearly always present in ambient air, absorbs infra-red light at nearly all wavelengths so that, irrespective of which optical filter is being used during the measurement sequence of the 1302, water vapour will contribute to the total acoustic signal in the analysis cell. The higher the concentration of water vapour in the cell the more it contributes to the measured signal. However, a special optical filter is permanently installed in the filter carousel of the 1302 which allows water-vapour's contribution to be measured separately during each measurement cycle. The 1302 is thus able to compensate for water-vapour's interference.

Any other interferent gas, which is known to be present in the ambient air, can be compensated for in a similar fashion. By installing an optical filter to selectively measure the concentration of the interferent gas, the user can "set-up" the 1302 to compensate for the interferent gas's contribution.

Calibration

After installation of relevant optical filters, the Multi-gas Monitor is zero-point calibrated (using clean, dry air), humidity-interference calibrated (using clean, wet air) and then span-calibrated (using a known concentration of each of the gases it is to monitor). Calibration is very easy — the user is guided through the procedure simply by following the directions which are displayed on the 1302's screen. Due to the 1302's high stability (low drift) calibration is seldom necessary more than four times a year.

Operation

The 1302 is operated by using the push-buttons on its front panel. Short self-explanatory text appears on the 1302's display screen to guide the operator in the use of these push buttons. There are four different operation modes: "Set-Up"; "Measurement"; "Memory"; and "Function".

User-defined Monitoring Task
Monitor gas A?/B?/C?/D?/E?
Monitor water vapour (Yes/No)?
Continuous Sampling (Yes/No)?
Sampling Interval?
Total Monitoring Period?
Compensate for Water Vapour?
Cross-compensate for Interference?

T020064280

Table 1. Monitoring-task "set-up" parameters which are user-definable

Set-Up Mode

When the 1302 is operated in "set-up" mode the user is able to select the parameters which define a particular monitoring task (see Table 1). Details of up to 10 different monitoring tasks can be stored in the 1302's memory. Each monitoring task "set-up" is given a number from 1-10.

When operating in "set-up" mode users are also able to select the parameters which determine, for example, the units of measurement (e.g. ppm or mg/m³ for gas concentrations); the interface and communication codes which enable measurement data to be printed and/or plotted out; the time over which measurements can be averaged (e.g. 15 min. if Short Term Exposure Levels (STEL) are required).

Measurement Mode

Operating in this mode the user selects the monitoring task he wishes the 1302 to perform, and the start-time of the task. The 1302's internal clock will automatically start the task at the pre-determined time. If a fixed monitoring period is chosen the 1302 will automatically stop the task at the end of the monitoring period; if the monitoring period is not fixed the 1302 will only stop monitoring when it is switched off manually.

Memory Mode

During a monitoring task all results are stored in a memory called *Display Memory*. While operating in "memory" mode data in this memory can be copied into (stored in) the 1302's other memory (called *Background Memory*) to prevent it being lost by being overwritten by results from the following new monitoring task.

Data stored in *Background Memory* can be recalled to *Display Memory* where the user can scroll through the measurement results on the 1302's display screen using the "Display" push-buttons. Data can also be deleted from *Background Memory* to enable new measurement data to be stored in it.

Function Mode

In this mode the user can "set-up" the 1302 to automatically perform almost any sequence of operations over any period of time. Using the front-panel push-buttons the user "keys-in" the sequence of operations he wishes the 1302 to perform. This "key sequence" is stored in the 1302's memory and the operation sequence automatically performed on request.

A "key sequence" could for example be used to "set-up" the 1302 to perform three different monitoring tasks during three consecutive work-shifts in a factory manufacturing 24 hours a day.

Measurement Results

Gas measurement results are displayed on the 1302's display screen as soon as they are available and are constantly updated. During a task the 1302 performs a running statistical analysis of measured gas concentrations. The Mean Value; the Standard Deviation; the Maximum and Minimum measured concentrations of each monitored gas are calculated. The Mean Value is the same as the Time-Weighted Average (TWA) value during the total monitoring period.

By pressing the **Average** push-button the individual gas-measurement results stored in *Display Memory* are automatically averaged and presented on the display. When the **Average** push-button is pressed again the original measurement results will again be shown on the display screen.

Measurement data stored in the 1302's *Display Memory* can be printed out in list form on the Brüel & Kjær Graphics Recorder Type 2313, or any standard text-printer, via either the

IEEE 488 parallel interface or the RS 232C serial interface port of the 1302. Data can also be represented graphically and plotted-out using the Brüel & Kjær Graphics Plotter Type 2319.

If any interesting or unusual event occurs during a monitoring task, the measurement being performed at this time can be marked by pressing the **Event Mark** push-button. This enables the user to assess the "event's" affect on the monitoring task.

Remote Control

The Multi-gas Monitor Type 1302 can be remotely controlled by computer via either the RS 232C or the IEEE 488 interface. Brüel & Kjær Application Software Type 7620 enables an IBM AT or PS/2-50 (or larger) computer to remotely control either a Multi-gas Monitor Type 1302 alone, or, alternatively, the 1302 together with one or two Multipoint Doser and Sampler Units Type 1303 (see Fig. 1). A single 1303 extends the monitoring capabilities of the 1302 substantially by enabling it to analyze air-samples from up to 6 different locations. The Application Software controls the whole system.

If the 1303 is only used as a "Sampler" the 1302 is able to sequentially monitor air-samples collected from up to 6 different locations; if the 1303 is used as a "Doser" and "Sampler" the 1303 can "dose" up to 6 different locations with a tracer gas and then draw air-samples from each of these locations for analysis by the 1302. The software analyzes the resultant measurements to calculate the air-change or ventilation efficiency of each location.

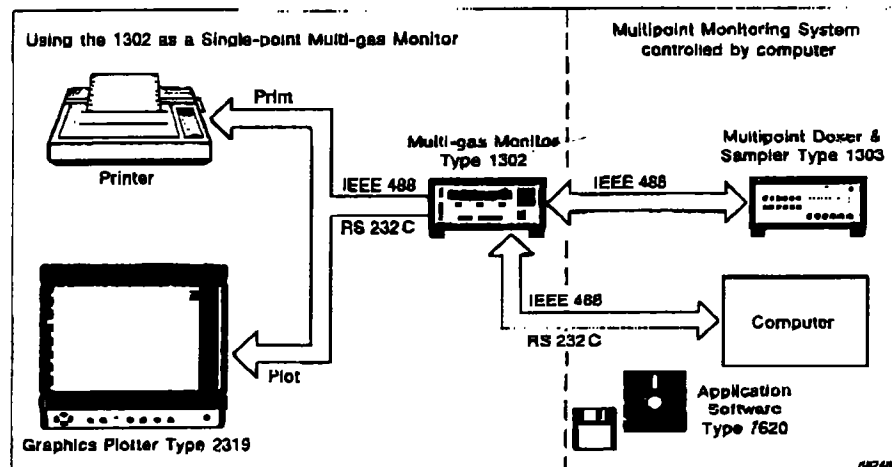


Fig. 1. Using the Multi-gas Monitor Type 1302 either alone, as a single-point multi-gas monitor, or together with a 1303 in a multipoint multi-gas monitoring system controlled by computer using available software

Reliability

Performance reliability is ensured by the series of self-tests which the 1302 performs. The self-tests include: checking software; data integrity and the electrical, mechanical and electronic parts of the 1302 to ensure that

it is functioning properly. If any fault is found, it is reported in the measurement results so that users can see what, if anything, has affected the accuracy of the measurement. If there is an AC mains power-supply failure the 1302 will automatically start-up again when power is restored.

Maintenance

The only maintenance tasks necessary are calibration and changing the fine filter-paper in the internal and external air-filtration units of the 1302. Both tasks are easily performed and should typically be necessary only four times a year.

Specifications 1302

All terms relating to gas analysis are in accordance with the definitions set out in the ISO Draft International Standard 8158

Your local Brüel & Kjær representative will assist in the selection of suitable optical filters. Details are provided in the "Optical Filters" Product Data Sheet.

If the optical filters necessary for the user's monitoring task are ordered together with the 1302 they are installed by B & K. The 1302 is then zero-point and humidity-interference calibrated. Span-calibration with a specific gas is optional. A "calibration chart" provided with the 1302 details the optical filters installed and the type of calibration performed with the 1302.

Optical filters can be bought at a later stage when new applications are found. Details of the installation of the filters and calibration of the 1302 are found in the 1302's Instruction Manual.

MEASUREMENT TECHNIQUE:

Photoacoustic Infra-red spectroscopy

RESPONSE TIME: (this includes the purging of the cell) is dependent on the number of gases being measured and the length of the sampling tube used. If the tube is less than 1 m then the response time is ~30 s if one gas or water vapour is measured, and ~105 s if 5 gases and water vapour are measured. Use of a 50 m tube will increase the response time.

MEASUREMENT RANGE:

Detection Threshold: is gas-dependent but typically ranges from 10^{-3} parts/million (ppm) to 1 ppm (see Product Data for the Optical Filters for examples of the detection threshold of some pure gases/vapours).

Dynamic Range: five orders of magnitude (that is, the upper detection limit = 100 000 times the lower detection limit). If the 1302 is required to measure over this wide dynamic range span-calibration has to be performed with two different gas concentrations. Users should be aware that certain gases in high concentration in the presence of water vapour could damage the 1302. Ask your local B & K specialist for further information.

MEASUREMENT UNITS:

in mg/m^3 and parts/million (ppm) normalized to the temperature entered by the user.

ACCURACY:

Zero Drift:

Typically = Detection Threshold per 3 months
Influence of temperature = $\pm 10\%$ of detection threshold/ $^{\circ}\text{C}$
Influence of pressure = $\pm 0.5\%$ of detection threshold/mbar

Repeatability: 1% of measured value

Range Drift:

$\pm 2.5\%$ of measured value per 3 months
Influence of temperature = $\pm 0.3\%$ of measured value/ $^{\circ}\text{C}$
Influence of pressure = -0.01% of measured value/mbar

REFERENCE CONDITIONS:

• Measured at 20°C , 1013 mbar, and relative humidity (RH): 80%.
• Measured at 1013 mbar, and RH: 60%.
• Measured at 20°C and RH: 60%.

CALIBRATION:

Calibration is a three/four-stage operation performed by consecutively attaching supplies of (1) dry air; (2) wet air; and (3) one or two different known concentrations of the gas-to-be-monitored to the 1302's air-inlet. Calibration is typically necessary only four times a year.

INTERFERENCE:

The 1302 automatically compensates for interference caused by temperature fluctuations in its analysis cell, and it can compensate for the presence of water vapour in the air sample. If an optical filter is installed to measure a known interferent the 1302 can cross-compensate for the interferent.

DATA STORAGE CAPACITY:

Can store measurement results from a 12-day monitoring task involving the monitoring of water vapour and 5 gases every 10 min.

GENERAL:

Cabinet: complies with IEC 629 Standards.

Dimensions:

Height: 175 mm (6.9 in)
Width: 395 mm (15.6 in)
Depth: 300 mm (11.8 in)
Weight: 8 kg (19.8 lbs)

Operating Temperature: $+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$

Relative Humidity: Up to 90% relative humidity at 30°C (non-condensing)

Maximum Pumping Rate: $30\text{ cm}^3/\text{s}$ (when purging the sampling tube) and $5\text{ cm}^3/\text{s}$ (when purging the analysis cell)

Volume of Air required per sample: (using a 1 m sampling tube) $140\text{ cm}^3/\text{sample}$

Power Requirement: 100 - 127 V and 200 - 240 V (50 - 400 Hz) $\pm 10\%$ AC. Complies with IEC 348 Class 1 Safety Standards

Power Consumption: ~100 VA.

Alarm Relay Socket: for connection to one or two alarm relays (visual/audio). Alarm levels for each gas are user-defined.

Acoustic Sensitivity: Not influenced by external sound

Electromagnetic Compatibility: Complies with U.S. FCC requirements for class B computing devices.

COMMUNICATION:

The 1302 has an IEEE 488 parallel interface and an RS 232C serial interface. Data can be both sent to and received from other equipment and the 1302 can also be remotely controlled via these interfaces. The RS 232C baud-rate is from 300-9600. The 1302 is able to convert data received via its RS 232C serial interface (e.g. from a computer) into data which can be sent on its IEEE 488 parallel interface to the 1303.

Back-up Battery: a 9V lithium battery, which has a life-time of 5 years, protects the data stored in the 1302's Display and Background memory and enables the internal clock to run.

ACCESSORIES INCLUDED:

Optical filter "locking" springs (8) DL 3322
Spanner (wrench) for internal air-filtration unit QA 0181
Fine filter-papers (10) for internal air-filtration unit DS 0714
External Air-filtration unit UD 5023
Fine filter-papers (25) for external air-filtration unit DS 0769
Tweezers QA 0184
Tool for "locking" spring QA 0170

Calibration Kit consisting of:

"Y"-piece UD 5001
Threaded Nuts (2) YM 0652
Polytetrafluoroethylene tubing AT 2177
Nylon (copolymer of tetrafluoroethylene & fluorosulphonyl monomer) tubing UD 5037
Fittings for tubing UD 5048

Lid to cover front panel FE 0023
"User's Guide to the Set-up Tree" OH 0029
Shoulder strap DH 0541
Mains cable with 3-pole female CEE plug AN 0010
Spare fuses:
110V, 1.25 A slow-blow (2) VF 0027
220V, 0.83 A slow-blow (2) VF 0032

ACCESSORIES AVAILABLE:

Optical Filters (22) UA 0988-UA 0988 and UA 0936
Span Calibration UA 1098
IEEE 488-IEEE 488 interface cable AO 0265
IEEE 488-IEC 625 interface cable AO 0264
RS 232C interface cable (25 pin - 25 pin) null-modem included WL 0947
6-pin DIN plug (male) with locking collar for alarm relay JP 0600
Polytetrafluoroethylene tubing AF 0614
Graphics Recorder Type 2313
Graphics Plotter Type 2319
Multipoint Sampler & Doser Unit Type 1303
Application Software Type 7620

Brüel & Kjær

Brüel & Kjær Instruments, Inc.

HEAD OFFICE: 185 Forest Street · Marlborough · MA 01752-3093 · (508) 481-7000 · TWX: 710-347-1187 · Fax.: (508) 485-0519
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MI (313) 522-8600 · IL (312) 358-7582 · TX (214) 751-1700 · CA (714) 978-8066 (415) 574-8100 · WA (206) 324-5905

PHOTOVAC

Technical Bulletin

#1

COMPOUNDS DETECTABLE WITH THE PHOTOVAC MICROTIP,
TIP, AND 10S SERIES OF PORTABLE GAS CHROMATOGRAPHS

TO:

JOHN KAISER

FROM: D. Turner 3 pages

Many of the chemicals mentioned herein are of a hazardous nature. Photovac expressly disclaims liability for any loss or injury arising out of the use of information, materials, equipment or practices described. Safe use of any procedure, equipment or material is the responsibility of the user.

For further information on contents of this bulletin or on Photovac products, please contact:

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Telex Answerback: PHOTO

<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (ev)</u>	<u>ANALYZER</u>
Propylene Oxide	10.22	GC/MicroTIP/TIP
n-Propyl Ether	9.27	GC/MicroTIP/TIP
n-Propyl Formate	10.54	GC/MicroTIP/TIP
Propyne	10.36	GC/MicroTIP/TIP
Pyridine	9.32	MicroTIP/TIP
Styrene	8.47	GC/MicroTIP/TIP
Tetrabromoethane	n.p.	GC/MicroTIP/TIP
Tetrachloroethene (PCE)	9.32	GC/MicroTIP/TIP
1,1,1,2-Tetrachloroethane	n.p.	GC/MicroTIP/TIP
1,1,2,2-Tetrachloroethane	n.p.	GC/MicroTIP/TIP
Tetrafluoroethene	10.12	GC/MicroTIP/TIP
Tetrahydrofuran	9.54	GC/MicroTIP/TIP
1,1,1,2-Tetrachloropropane	n.p.	GC/MicroTIP/TIP
1,2,2,3-Tetrachloropropane	n.p.	GC/MicroTIP/TIP
Thioethanol	9.29	GC/MicroTIP/TIP
Thiomethanol	9.44	GC/MicroTIP/TIP
Thiophene	8.86	GC/MicroTIP/TIP
1-Thiopropanol	9.20	GC/MicroTIP/TIP
Toluene	8.82	MicroTIP/TIP
o-Toluidine	7.44	GC/MicroTIP/TIP
Tribromoethene	9.27	GC/MicroTIP/TIP
1,1,1-Trichlorobutanone	9.54	GC/MicroTIP/TIP
1,1,1-Trichloroethane *	11.25	GC/MicroTIP/TIP
1,1,2-Trichloroethane	n.p.	GC/MicroTIP/TIP
Trichloroethene (TCE)	9.45	GC/MicroTIP/TIP
Trichloromethyl Ethyl Ether	10.08	GC/MicroTIP/TIP
1,1,2-Trichloropropane	n.p.	GC/MicroTIP/TIP
1,2,3-Trichloropropane	n.p.	MicroTIP/TIP
Triethylamine	7.50	GC/MicroTIP/TIP
1,2,4-Trifluorobenzene	9.37	GC/MicroTIP/TIP
1,3,5-Trifluorobenzene	9.32	GC/MicroTIP/TIP
Trifluoroethene	10.14	GC/MicroTIP/TIP
1,1,1-Trifluoro-2-iodoethane	10.10	GC/MicroTIP/TIP
Trifluoroiodomethane	10.40	GC/MicroTIP/TIP
Trifluoromethylbenzene	9.68	GC/MicroTIP/TIP
Trifluoromethylcyclohexane	10.46	GC/MicroTIP/TIP
1,1,1-Trifluoropropene	10.90	MicroTIP/TIP
Trimethylamine	7.82	GC/MicroTIP/TIP
2,2,4-Trimethyl Pentane	9.86	GC/MicroTIP/TIP
2,2,4-Trimethyl-3-pentanone	8.82	GC/MicroTIP/TIP
n-Valeraldehyde	9.82	GC/MicroTIP/TIP
Vinyl Acetate	9.19	GC/MicroTIP/TIP
Vinyl Bromide	9.80	GC/MicroTIP/TIP
Vinyl Chloride	10.00	GC/MicroTIP/TIP
4-Vinylcyclohexene	8.93	GC/MicroTIP/TIP
Vinyl Ethanoate	9.19	GC/MicroTIP/TIP
Vinyl Fluoride	10.37	GC/MicroTIP/TIP
Vinyl Methyl Ether	8.93	GC/MicroTIP/TIP

<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)</u>	<u>ANALYZER</u>
o-Vinyl Toluene	8.20	MicroTIP/TIP
o-Xylene	8.56	GC/MicroTIP/TIP
m-Xylene	8.56	GC/MicroTIP/TIP
p-Xylene	8.45	GC/MicroTIP/TIP
2,4-Xylidine	7.65	MicroTIP/TIP

Notes

- * The sensitivity of the TIP, MicroTIP, and GC to these compounds may be enhanced by using an 11.7 eV lamp instead of the standard 10.6 eV lamp energy.

n.p. - Not published

Many compounds not appearing in this list, with an ionization potential of 12.0 eV or less, may also be detectable.

Ionization potentials for several other compounds can be found in Ionization Potential and Appearance Potential Measurements, 1971-1981, R.D. Levin and S.G. Lias, National Bureau of Standards, Washington, D.C., October 1982.

For further information, please contact the Technical Services/Applications Department at Photovac International Inc.

TIPTM, MicroTIPTM, and 10STM are Trademarks of Photovac Incorporated. Cellosolve[®] is a Registered Trademark of Union Carbide Corp. Freon[®] is a Dupont Registered Trademark.



April 30, 1996

Document No.: 08519.405

Commanding Officer
Attn: Mr. Wayne Hansel, Code 18B7
SOUTHNAVFACENGCOM
2155 Eagle Drive
N. Charleston, SC 29419-9010

Subject: Final OU4 IRA Focused Field Workplan, NTC Orlando
CTO 107, Contract No.: N62467-89-D-0317

Dear Mr. Hansel:

Enclosed are copies of the subject document for NTC, Orlando. This workplan addresses that field work associated with the Area "C" laundry PCE plume and Lake Druid investigation. This document contains all comments received during the April OPT meeting and minor additions/corrections that we had found since the meeting. As planned, field work is expected to begin later this week.

If you have any questions or need further information please contact me at 407/895-8845.

Very Truly Yours,

ABB ENVIRONMENTAL SERVICES, INC.

A handwritten signature in cursive script, reading 'John P. Kaiser'.

John P. Kaiser
Installation Manager

JPK/lak
Enclosure

cc: Barbara Nwokike (SDIV) w/1 enc.
LCDR Catherine Ballinger (NTC, Orlando) w/1 enc.
Nancy Rodriguez (USEPA) w/2 enc.
Oscar McNeil (BEC) w/1 enc.
John Mitchell (FDEP) w/2 enc.
Mark Zill (NTC, Orlando) w/1 enc.

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ABB Environmental Services Inc.

**INTERIM REMEDIAL ACTION
FOCUSED FIELD INVESTIGATION WORKPLAN
OPERABLE UNIT 4**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**

Unit Identification Code: N65928

Contract No.: N62467-89-D-0317/107

Prepared by:

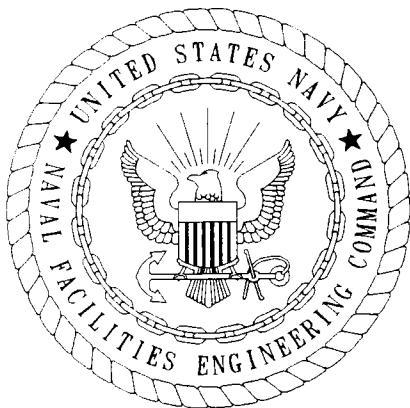
**ABB Environmental Services, Inc.
2590 Executive Center Circle, East
Tallahassee, Florida 32301**

Prepared for:

**Department of the Navy, Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29418**

Barbara Nwokike, Code 1873, Engineer-in-Charge

April 1996



CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, ABB Environmental Services, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/107 are complete and accurate and comply with all requirements of this contract.

DATE: April 30, 1996

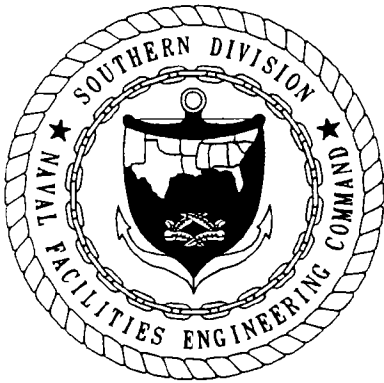
NAME AND TITLE OF CERTIFYING OFFICIAL: John P. Kaiser
Task Order Manager

NAME AND TITLE OF CERTIFYING OFFICIAL: Mark Salvetti, P.E.
Project Technical Lead

(DFAR 252.227-7036)

The Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM); the U.S. Environmental Protection Agency (USEPA); and the Florida Department of Environmental Protection collectively coordinate the cleanup activities through the BRAC Cleanup Team, called the Orlando Partnering Team in Orlando. This team approach is intended to foster partnering, accelerate the environmental cleanup process, and expedite timely, cost-effective, and environmentally responsible disposal and reuse decisions.

Questions regarding the BRAC program at Naval Training Center, Orlando should be addressed to the SOUTHNAVFACENGCOM BRAC Environmental Coordinator, Mr. Wayne Hansel, Code 18B7, at (407) 646-5294 or SOUTHNAVFACENGCOM Engineer-in-Charge, Ms. Barbara Nwokike, Code 1873, at (803) 820-5566.



FOREWORD

To meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and leaks and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense (DOD) initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at their facilities.

One of these programs is the Base Realignment and Closure (BRAC) Cleanup program. This program complies with the Base Closure and Realignment Act of 1988 (Public Law [P.L.] 100-526, 102 Statute 2623) and the Defense Base Closure and Realignment Act of 1990 (P.L. 101-510, 104 Statute 1808), which require the DOD to observe pertinent environmental legal provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the 1992 Community Environmental Response Facilitation Act; Executive Order 12580; and the statutory provisions of the Defense Environmental Restoration Program, the National Environmental Policy Act (NEPA), and any other applicable statutes that protect natural and cultural resources.

CERCLA requirements, in conjunction with corrective action requirements under Subtitle C of the Resource Conservation and Recovery Act (RCRA), govern most environmental restoration activities. Requirements under Subtitles C, D, and I, of RCRA, as well as the Toxic Substances Control Act, the Clean Water Act, the Clean Air Act, the Safe Drinking Water Act, and other statutes, govern most environmental mission or operational-related and closure-related compliance activities. These compliance laws may also be applicable or relevant and appropriate requirements for selecting and implementing remedial actions under CERCLA. NEPA requirements govern the Environmental Impact Analysis and Environmental Impact Statement preparation for the disposal and reuse of BRAC installations.

The BRAC program centers on a single goal: expediting and improving environmental response actions to facilitate the disposal and reuse of a BRAC installation, while protecting human health and the environment.

EXECUTIVE SUMMARY

ABB Environmental Services, Inc. (ABB-ES), under contract to the Southern Division, Naval Facilities Engineering Command, has prepared this Interim Remedial Action (IRA) Focused Field Investigation Workplan to enable proper conduct of work at Operable Unit (OU) 4 (Area C) at Naval Training Center (NTC), Orlando. Area C is composed of Study Areas (SA) 12, 13, and 14. This workplan only addresses part of SA 13. This workplan and the subsequent IRA are required based on recent screening events at the site that showed surface water and groundwater concentrations of chlorinated volatile organic compounds; tetrachloroethene, trichloroethene, and vinyl chloride, (cis-DCE) arsenic, and beryllium exceed State and Federal regulatory criteria.

This workplan has been developed with input from the Orlando Partnering Team and is intended to be a dynamic document permitting flexibility during the implementation of this investigation at Area C, NTC, Orlando. Because of elevated concern for Lake Druid water quality and the known contamination levels west of Building 1100 (the old laundry), the approach taken in this workplan is twofold. First, emphasis will be placed on investigating and understanding the potentially affected media of the lake's surface water and sediments as guided by investigative methods. The results of this phase may provide enough information to determine the proper level of remedial action. Second, groundwater and geologic information between the lake and Building 1100 will be investigated only to the extent needed to support ultimate mitigation of lake and surface water contamination.

Even though the areal size of OU 4 is large and may extend north, east, and south beyond Building 1100, this workplan is restricted and focused on the area west of the laundry building. However, all information gathered will support future remedial investigation and feasibility study actions. The information gathered will be integral in the determination of applicable short-term remediation technologies, the need for a treatability study, and a remediation system design.

The overall objective of this workplan is to collect only those data that support a relatively quick initial remedial solution. The field program proposed in this document has been developed to support that objective. It will include the use of a mobile lab for quick decision making; the use of direct-push technology for minimal cost and intrusive impact, the collection of sediment and surface water samples, and the possible installation of a minimum number of wells to confirm sample methods and provide monitoring capabilities. All results will be documented in field logs, discussed at periodic and advertised meetings, and presented in a final IRA field report.

In order to expedite these interim remediation activities and minimize costs, the workplan has incorporated by reference elements of the Project Operations Plan (ABB-ES, 1994a) which includes elements of the Quality Assurance Project Plan, Health and Safety Plan, and the Field Sampling Plan.

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Naval Training Center
Orlando, Florida

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- Attachment A: Area C Preliminary Risk Evaluation
- Attachment B: Initial Screening Results
- Attachment C: Area C Supplemental Health and Safety Plan Addendum

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Focused Field Investigation Workplan, OU 4
Naval Training Center
Orlando, Florida

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
bls	below land surface
BRAC	Base Realignment and Closure Program
BTEX	benzene, toluene, ethylbenzene, and xylenes
CA	chloroethane
CLP	Contract Laboratory program
CLP-RAS	Contract Laboratory program-Routine Analytical Services
COC	contaminants of concern
DCE	transdichloroethylene
DI	deionized
DPT	Direct-Push Technology
DQO	data quality objective
DRMO	Defense Reutilization and Marketing Office
EBS	Environmental Baseline Survey
ELCD	electrolytic conductivity detector
FDEP	Florida Department of Environmental Protection
GC	gas chromatograph
HP	Hewlett-Packard
I.D.	identifier
ID	inner diameter
IDW	Investigative Derived Waste
IRA	interim remedial action
MCL	maximum contaminant level
MDL	method detection limit
ml	milliliter
mm	millimeters
MS/MSD	matrix spike and matrix spike duplicate
$\mu\text{g/kg}$	microgram per kilogram
$\mu\text{g/l}$	microgram per liter
msl	mean sea level
NTC	Naval Training Center
OPT	Orlando Partnering Team
OU	operable unit
PCE	tetrachloroethene
PID	photoionization detector
POP	Project Operations Plan
PPE	personal protective equipment
PQL	practical quantitation limit
ppb	parts per billion

GLOSSARY (Continued)

PRE	preliminary risk evaluations
QA/QC	quality assurance and quality control
RI/FS	Remedial Investigation/Feasibility Study
RPD	relative percent difference
SA	study area
SCM	site conceptual model
TCE	tetrachloroethylene
TCL	Target Compound List
UIC	Unit Identification Code
USCS	Unified Soil Classification System (USCS)
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VOC	Volatile Organic Compound

1.0 INTRODUCTION

1.1 INTERIM REMEDIAL ACTION (IRA) FOCUSED FIELD INVESTIGATION, SCOPE, AND OBJECTIVES. This IRA Workplan establishes the background, rationale and plans for further assessment of potential contamination impact to Lake Druid, located in Study Area (SA) 13, at Naval Training Center (NTC), Orlando's Area C property. The purpose of the IRA is for the development and implementation of a remedial strategy to mitigate the potential effects of the volatile organic compounds (VOCs) on the environment and surroundings at SA 13 based on the results gained from this assessment. This investigation will be conducted to characterize the nature and extent of the VOCs that were detected in the surface water and sediments of Lake Druid during an earlier site screening field program. Previous investigations also confirmed the presence of VOCs in the groundwater at locations adjacent to Building 1100. The IRA focused field investigation is designed to establish the source of VOCs in Lake Druid, characterize it, and support an IRA to mitigate the contamination in the lake.

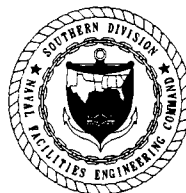
The specific objectives of the field program are to provide sufficient information to evaluate the following:

- the extent of contamination in the lake's surface water and sediment,
- the source(s) of VOCs in Lake Druid,
- the physical characteristics of the lake,
- the horizontal and vertical extent of groundwater contamination along the lakeshore,
- if necessary, further characterize the groundwater contamination upgradient from the lake, and
- support a focused, IRA to mitigate VOCs in Lake Druid.

1.2 SITE DESCRIPTION. Operable Unit (OU) 4 is composed of SAs 12, 13, and 14 as referred to in the Draft Group I and II Site Screening Report (ABB Environmental Services, Inc. [ABB-ES], 1995). Area C (Figures 1-1 and 1-2) occupies 46 acres and is located approximately 1 mile west of the Main Base off Maguire Boulevard. Area C serves as a supply center for NTC, Orlando and includes a laundry and drycleaning facility, which is now closed, and the Defense Reutilization and Marketing Office (DRMO). It is surrounded by urban development, including single- and multifamily residential developments to the north and south, Lake Druid to the west, and an office park to the east. There are no industrial facilities adjacent to Area C. This IRA will focus on approximately 6 acres of Area C property west of SA 13, including the eastern shore area of Lake Druid. Four of these acres are densely vegetated with large trees and heavy undergrowth. The remaining 2 acres have been classified as Palustrine wetland by the U.S. Department of the Interior, Fish and Wildlife Service. This includes a buffer strip along Lake Druid approximately 150 feet wide, which was defined by a March 1996 walkover of the area by the St. Johns River Water Management District. This



FIGURE 1-1
SITE LOCATION MAP



**INTERIM REMEDIAL ACTION
FOCUSED FIELD INVESTIGATION**

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1.2.3 Contaminant of Concern The primary contaminant of concern at OU 4 is tetrachloroethylene (PCE), a chlorinated solvent that was used extensively in the drycleaning operations at Building 1100. Due to a reported history of relatively poor storage and handling techniques, there have been occurrences of spills and the subsequent release of this contaminant into the immediate area.

Over time and under varying conditions (aerobic and anaerobic), PCE has the potential to degrade into trichloroethylene (TCE), transdichloroethylene (trans-DCE), cis dichloroethylene (cis-DCE), vinyl chloride (VC), and chloroethane (CA). To date, varying concentrations of PCE, TCE, DCE, and VC have been found in surface water and sediment samples collected along the eastern edge of Lake Druid. Varying concentrations of PCE, TCE, VC, and DCE have also been found in groundwater and subsurface soil samples collected at OU 4.

2.0 SITE HISTORY AND SETTING

According to available information, the laundry was in operation at Building 1100 from the 1940s until the fall of 1994. During the early stages of its existence, the operation only utilized conventional water-based laundry equipment. Drycleaning equipment was installed at the laundry during the early 1960s. Archived construction plans suggest that trench drains in the floor of the laundry were utilized to drain effluent from the conventional machines into the sanitary system. Although the drycleaning machines were designed and constructed as closed systems, any spill and/or leak of the drycleaning fluid PCE would likely also reach the trench drains and be flushed to the sanitary outlet with the effluent. At some point in the 1960s, a problem developed with the outlet to the sanitary system in that the discharge pipe was of insufficient diameter to handle the volume of effluent draining from the floor. This apparently resulted in regular overflows of the effluent onto the ground surface at the sanitary inlet located on the west side of the laundry. A settling and/or surge tank was installed during the mid-1960s to address this problem. The tank system operated by storing the effluent from the drain system and then incrementally pumping it into the sanitary system.

2.1 INVESTIGATION HISTORY AND REVIEW OF EXISTING DATA. Building 1100 was included as part of SA 13 during the environmental baseline survey (EBS) (ABB-ES, 1994b), and placed into Group II for screening. The screening investigation at SA 13 was performed in the spring of 1995. SA 13 includes the NTC Laundry and Drycleaning Facility (Building 1100) and the former location of a Boiler House (Building 1101). SA 13 is located in the northwest corner of Area C at Port Hueneme Avenue and Davisville Street. Building 1101 was located east of Building 1100 and was demolished some time after 1962.

Building 1100 was constructed in 1943 and is a single-story wood-framed structure that has always been used as an industrial laundry and drycleaning facility, serving the entire military base. The surrounding property is paved asphalt, except for small areas east and west of the building that are landscaped and grass covered. The paved areas around the perimeter of the building include roads and parking lots. Prior to construction of the facility in 1943, the land was undeveloped. The laundry was closed in the fall of 1994.

Reportedly, hazardous wastes generated and materials used in the drycleaning process have been poorly managed. At the time of the baseline survey, there were reportedly many containers in the building, ranging in volume from $\frac{1}{2}$ to 55 gallons that were open and not labeled. The facility has received a Notice of Violation and a citation from Florida Department of Environmental Protection (FDEP) for unlabeled and unmanifested waste.

Wastewater from the laundry machines discharged to the sanitary sewer through badly deteriorated drainage trenches in the floor. The floor trenches discharge to a single pipe that is connected to a settling and surge tank. Due to the volume of water discharged in this area, a 30,000-gallon surge tank was installed in the mid-1960s. Sludge was removed from this tank annually and disposed of by the DRMO. Waste filters from the drycleaning machines were also generated at the facility. PCE was separated from the water and filters by heating the assemblies in a pressure cooker. The filters were disposed of through the DRMO and the

solvent recycled. In the past, the filters were allegedly disposed of in the North Grinder Landfill (ABB-ES, 1994b).

Discharges of water contaminated with chlorinated solvents have reportedly occurred on the property. Discharges of water from the washing machines to Lake Druid have also been reported.

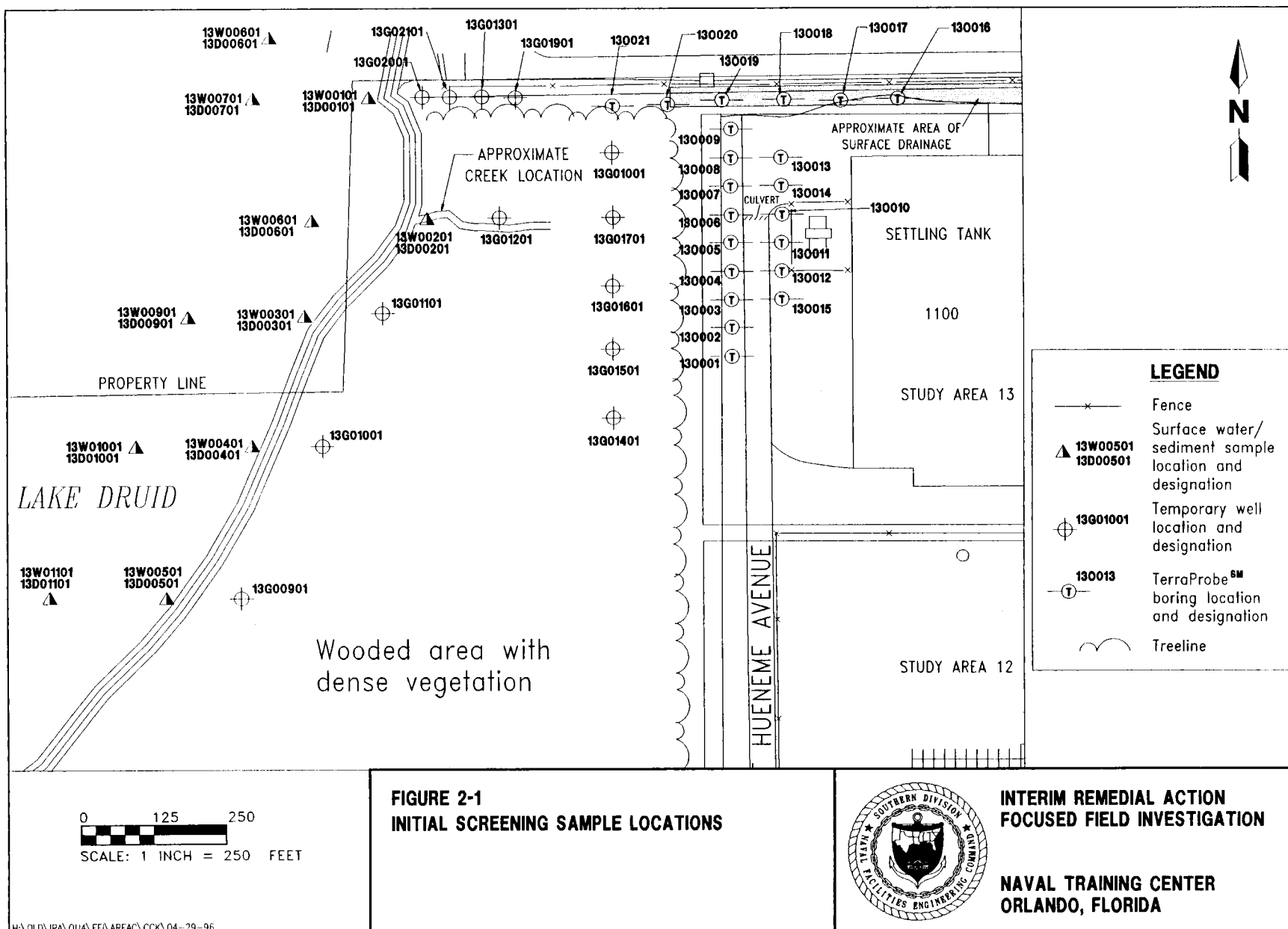
The site screening investigation conducted at Area C included a soil gas survey, surface and subsurface soil sampling, and the installation of 16 monitoring wells to evaluate groundwater. Twelve wells were placed to evaluate the shallow surficial aquifer and were installed to a depth of approximately 15 to 20 feet bls. Four wells in the immediate vicinity of the laundry were screened at the base of the surficial aquifer, approximately 60 feet bls. Saturated soil samples were collected approximately every 6 feet from the interval between the shallow and deep wells and analyzed on a field gas chromatograph (GC). Combined with the groundwater samples collected from the monitoring wells, these data contributed to the evaluation of the surficial aquifer.

The results of the site screening investigation are provided in detail in the Draft Site Screening Report for Groups I and II (ABB-ES, 1995). Volatile organic detections are summarized on Figure 1-1 of Attachment A. PCE and TCE were detected above the Florida maximum contaminant level (MCL) of 3 micrograms per liter ($\mu\text{g}/\ell$) in several shallow monitoring wells. The highest concentrations of each compound were detected in shallow monitoring well OLD-13-07A, located west of the laundry. PCE and TCE were also detected in the deep well OLD-13-08C, but at concentrations below the MCL. PCE was also found in deep well OLD-13-02C at concentrations below the MCL. Field GC data for soils collected in this vicinity detected PCE and TCE in saturated soil approximately 18 feet bls at concentrations of 3,700 micrograms per kilograms ($\mu\text{g}/\text{kg}$) and 1,300 $\mu\text{g}/\text{kg}$, respectively.

Lake Druid was not included in the original site screening investigation. After reviewing the site screening data, the Orlando Partnering Team (OPT) requested that surface water and sediment samples be collected from the lake.

On November 29, 1995, surface water and sediment samples were collected along the shoreline of Lake Druid. These samples were analyzed by an offsite laboratory by U.S. Environmental Protection Agency (USEPA) Method 8010. PCE, TCE, cis-1,2-dichloroethene (cis-DCE), 1,1-DCE, and VC were detected at these locations. At some locations, TCE and cis-DCE were detected in surface water at concentrations greater than had been detected in groundwater collected from the monitoring wells during site screening. Vinyl chloride and 1,1-DCE had not been detected in groundwater.

On December 11, 1995, additional surface water and sediment samples were collected in Lake Druid approximately 50 feet west of the November locations as shown on Figure 2-1. Analytical results are summarized in Attachment B. The water depth was approximately 4 feet. Cis-DCE was detected in surface water collected from each location further out in the lake. TCE was also detected in surface water from sample location 13D/W00801. TCE and PCE were detected in sediment from this location and from location 13W/D00901. Chlorinated solvent concentrations from the locations further out in the lake were generally much lower than at the shoreline, sometimes by two orders of magnitude.



During the week of December 18, 1995, groundwater samples were collected from the area between the lake and Building 1100 for further screening. Samples were collected from temporary wells installed by hand auger in the heavily vegetated areas and from TerraProbeSM rig borings placed in the open areas. Sample points were placed along several north-south lines as well as along the northern perimeter fenceline (Figure 2-1).

Samples collected from the temporary wells were limited to the water table, and were screened with a portable GC and sent off site for laboratory analysis. Samples were collected from three depth intervals at each TerraProbeSM boring; at the water table, at approximately 18 bls, and at 30 feet bls. Analysis of the TerraProbeSM samples included the field GC and laboratory. The results of this most recent phase of screening show that PCE and TCE are present at elevated concentrations down to 30 feet in depth, below which, samples were not taken. The GC and laboratory analytical results from the initial screening programs are presented in Attachment B.

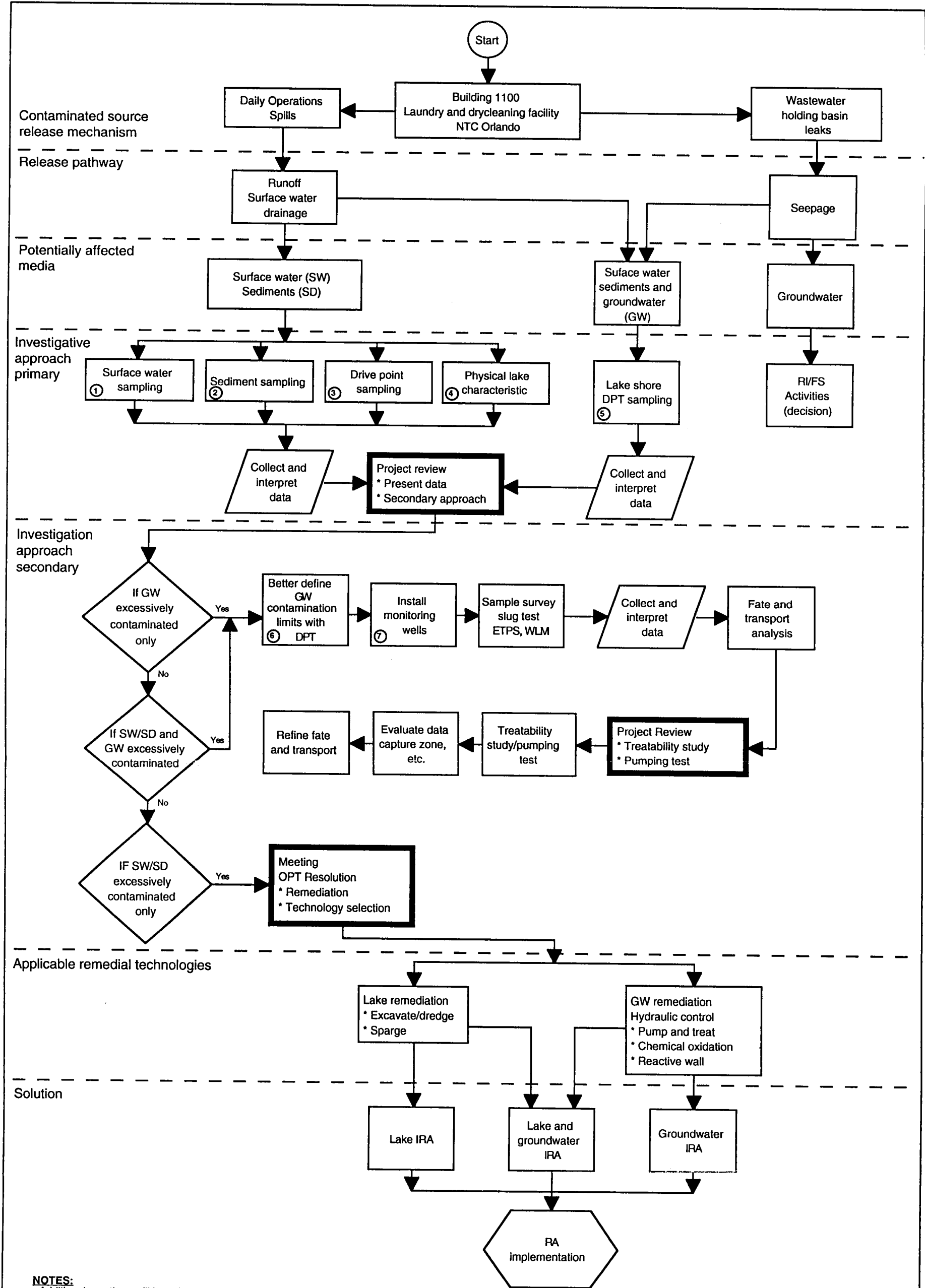
2.2 DATA NEEDS EVALUATION. This section presents a discussion of the data quality needs to meet the objectives of the investigation.

2.2.1 Site Conceptual Model The site conceptual model (SCM) is a framework within which the source, release mechanism(s), and environmental pathways of potential concern are identified. The SCM is best represented by the Project Logic Chart (Figure 2-2). This diagram identifies the data needs, as well as the approach to collection and evaluation of those data. This logic diagram is discussed below and in Chapter 3.0 of this workplan. This SCM identifies media that will require sampling to evaluate contaminant release(s). The model also serves as a framework for conceptualizing applicable remedial technologies and focusing activities toward a solution. The model is based on the current understanding of the contaminated media and environmental pathways. Source areas are those where releases of chlorinated solvents are documented or believed to have occurred. A contaminant release mechanism is defined as a process that results in migration of a contaminant from a source area into the immediate environment. Once in the environment, contaminants can be transferred between media and transported away from the source and/or site.

The source area for this IRA focused field investigation is, in general, the Laundry and Drycleaning Facility, Building 1100. The contaminant source release(s) is believed to be one or a combination of two scenarios. The first scenario considers operational spills either on the ground surface outside the building or in the building drain system. The other release mechanism considers seepage from the settling tank located to the west of the facility. Affected media, as determined from prior investigations, are surface water and sediment at the edge of Lake Druid, and groundwater and subsurface soil between the facility and the lake.

There are potential release pathways for contaminant migration:

- (1) The transport of the chlorinated solvents by stormwater runoff into the swale and culvert and thereby directed into the lake.



NOTES:

- Additional meetings will be scheduled as needed
- Refer to work plan text and figures for definition of tasks 1 through 7
- NTC = Naval Training Center
- SW = surface water
- SD = sediments
- RI/FS = Remedial Investigation/Feasibility Study
- DPT = Direct Push Technology
- ETPs = engineering treatability parameters
- WLM = water level measurement
- IRA = Initial Remedial Action
- RA = Remedial Action

**FIGURE 2-2
SITE CONCEPTUAL MODEL:
PROJECT LOGIC DIAGRAM**

**INTERIM REMEDIAL ACTION
FOCUSED FIELD INVESTIGATION**

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- (2) Seepage of the chlorinated solvents through the soil and into the groundwater, thereby affected by groundwater flow and potentially migrating toward the lake.

Investigations in the IRA focused field investigation will determine the degree and extent of impact in the lake areas and the extent to which one or more of these mechanisms may have played in the mobilization and deposition of the contaminants.

Potential exposure pathways to the chlorinated solvents exist in the event of dermal contact, ingestion, or inhalation of surface water, sediment, groundwater, and air. Current receptors could potentially include ecological types (biota), recreational users of Lake Druid, and offsite residents living along the lake.

The exposure potential to these probable and potential contaminated media based on previous site screening results are discussed in greater detail in the Area C PRE (Attachment A).

2.2.2 Data Quality Objectives (DQOs) DQOs are qualitative or quantitative statements developed by the data user to specify the quality of data needed from a particular data activity to support specific decisions. The DQOs are the starting point in the design of an investigation. The DQO development process matches sampling and analytical capabilities to the data targeted for specific uses and ensures that the quality of the data does not underestimate project requirements. The USEPA has identified five general levels of analytical data quality as being potentially applicable to field investigations conducted at potential hazardous waste sites under Comprehensive Environmental Response, Compensation, and Liability Act. These levels are summarized below and discussed in the project operations plan (POP), Section 3.2, Data Quality Objectives (ABB-ES, 1994a).

- (1) Level I, Field Screening. Characterized by use of portable field instruments that can provide real-time data both for personnel health and safety and to optimize locating sampling points.
- (2) Level II, Field Analysis. Characterized by use of portable analytical instruments for onsite use or in mobile laboratories near a site.
- (3) Level III, Laboratory Analysis. Characterized by use of methods other than the Contract Laboratory program (CLP) Routine Analytical Services (CLP-RAS), but which may be equivalent without the CLP requirements for documentation.
- (4) Level IV, Laboratory Analysis CLP-RAS. Characterized by rigorous quality assurance and quality control (QA/QC) protocols and documentation, providing qualitative and quantitative analytical data.
- (5) Level V, Nonstandard methods. Includes analyses that may require modification and/or development.

The objectives of data collection are as follows:

- Hydrogeologic information will be collected to evaluate groundwater migration, flow gradients, and stratigraphy.

- Sediment and surface water samples will be collected to delineate the degree and extent of impact and to support exposure and risk evaluations for human health and ecological receptors and to evaluate impacts from potential remediation. Additionally, data will be collected to evaluate leachability of potential contaminants in the sediments.
- Groundwater samples will be collected to delineate the degree and extent of impact to the groundwater.

2.3 PROJECT APPROACH OVERVIEW. The project approach can best be presented as the flowchart provided in Figure 2-2. The chart illustrates the probable sources and pathways of contaminants and the investigative approach selected to best reach the goals. The flowchart recognizes critical areas where project reviews will take place with the OPT and decisions will be made relative to the future direction of the investigation. The flowchart approach focuses on characterizing and mitigating VOCs in Lake Druid. Also, the approach realizes that complete characterization of the Area C laundry facility is not required or necessary at this time but will be accomplished during the remedial investigation and feasibility study (RI/FS) scope of work in the future. This approach emphasizes the collection of data only to support the objectives of the project and to manage the uncertainties through applied judgement and communication with the OPT. Because the focus is mitigating VOC contamination in Lake Druid, the primary decisions will be to: (1) determine the source(s) and extent of VOC contamination in lake water and sediment; (2) evaluate groundwater contamination to the extent necessary to support the lake characterization and interim action; and (3) select the technology (ies) most appropriate to treat and/or control the VOCs.

This workplan was developed to give direction to the investigation in meeting the project objectives. The investigation will be considered complete when it is possible to identify probable conditions and/or characteristics, differentiate among alternatives of the remedial action, and identify any reasonable deviations.

3.0 INVESTIGATION APPROACH

3.1 PRELIMINARY ACTIVITIES. This section describes the activities that will be performed before beginning the field sampling program.

3.1.1 Subcontract Coordination ABB-ES will contact all appropriate subcontractors to finalize remaining contractual matters and plan the mobilization and related activities associated with field work. Coordination activities include: scheduling, staffing, and procurement of all personnel, materials, equipment, and supplies required to complete the proposed work. Subcontractors include the direct-push contractor, drilling contractor, clearing and handling contractor, land surveyors, and analytical laboratories. A USEPA- and Naval Energy and Environmental Support Activity-approved laboratory will be selected.

3.1.2 Site Access, Permitting, Authorization In conjunction with subcontractor scheduling, ABB-ES will ensure that the necessary authorization and approval is secured for all vehicles and personnel scheduled for field activities. The NTC, Orlando environmental coordinator will be contacted to arrange authorization for the appropriate vehicle passes and contractor identification badges for ABB-ES and subcontractor personnel and their vehicles. Such badges will permit authorized personnel to enter specified areas of the facility for the purpose of completing the approved fieldwork. ABB-ES will ensure that all necessary permits (excavation permits for direct-push penetrations and drilling) have been obtained through the environmental coordinator and/or appropriate State agencies before mobilization for fieldwork.

Before mobilization for fieldwork, ABB-ES will coordinate with a subcontractor to clear the heavy brush and vegetation from the investigated area. The site will be cleared and improved so a drill rig can access the investigative area. Care will be taken to preserve the natural flora in the investigated area. Also ABB-ES will coordinate with public works at NTC, Orlando to identify and locate all underground utilities and other underground structures, as well as overhead utilities that could obstruct field activities. Upon mobilization to the field, ABB-ES will work with base personnel to mark each utility for future reference. This action will minimize the health and safety risks of field personnel and help protect the integrity of the utility. Identification and location of utilities could include referring to blueprints and using electronic equipment in the field to locate utility lines.

3.1.3 Mobilization and/or Demobilization Prior to mobilization, all field personnel will be briefed on the project Health and Safety Plan as amended by Attachment C and other in-process changes that will address such things as boating safety and sediment sampling. Mobilization is expected to begin the week of April 29, 1996, with the arrival of the ABB-ES-ES Field Operations Lead and chemists. These personnel will set up the field laboratory and coordinate all permitting and access activities. The field sampling program will begin with surface water and sediment sampling. Two days will be required to demobilize at the end of the sampling program.

3.2 FIELD INVESTIGATION. The objectives of the IRA focused field investigation program are: (1) identifying the source(s) and extent of contamination in Lake Druid, (2) characterizing the subsurface immediately upgradient along the

lakeshore, and (3) if necessary, further characterizing the aquifer upgradient from the lake. The field sampling effort will follow the procedures outlined in the POP for NTC Orlando, including procedures for collection of groundwater and surface water samples, sediment samples, topographic surveying, documentation, field monitoring instrumentation, field equipment decontamination procedures, and QA/QC procedures.

3.2.1 Surface Water and Sediment Sampling Surface water and sediment samples will be collected from at least 20 locations in Lake Druid. The sample locations will begin along the shoreline and proceed from the known hot spots, north and south along the shore at 25 feet spacing for approximately 500 feet, or until no impact to surface water or sediments is found, as shown on Figure 3-1. A "grid pattern" will be sampled that extends westward into the lake. Additional sampling locations will be dependent on the results from the shoreline survey of samples. Any shoreline sample with VOC concentrations above Florida's surface water standards shall be delineated to the north, south, and west of the contaminated sample locations. Surface water and sediment sampling will continue until the limits of VOC(s) impact on the lake have been horizontally delineated. Samples will be screened for VOC's at the field laboratory allowing the field team to efficiently delineate VOCs in the lake. Samples will also be taken from a small creek located about 100 feet south of the Area C fenceline.

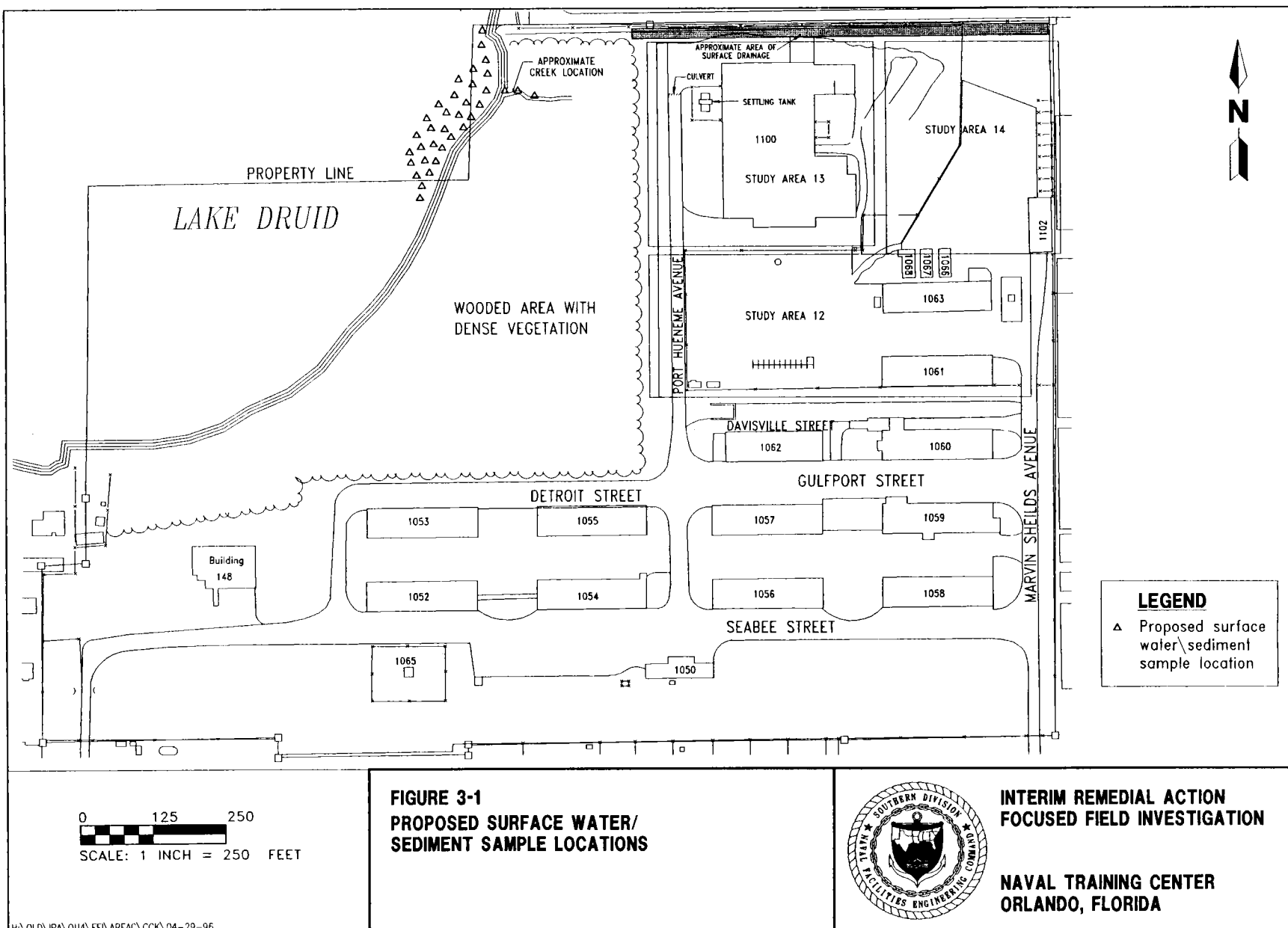
In areas greater than one foot in depth, surface water samples will be collected from just under the surface of the lake and directly above the sediment at each location using a direct sampling device. At locations where the water depth is less than one foot a single sample will be collected just above the sediment. Sediment samples will be collected using a stainless steel sleeved, drive type device similiar to that of a split spoon for minimizing sediment disturbance. Sediment sample will be collected in the removable sleeves approximately one foot in length, and sent to the field laboratory for analysis.

Horizontal delineation of surface water and sediments will be dependent on Primary Florida Groundwater Guidance concentrations for cis-DCE and VC and Florida's surface water standards for all other analyzed VOC's.

After horizontal delineation and evaluation of the available data, further surface water and sediment sampling may be required for collecting treatability parameters.

3.2.2 Lake Druid Source Evaluation In order to further determine the source of VOC contamination in Lake Druid, a source evaluation will be implemented. The evaluation will include: (1) interpretation of flow mechanics from the surficial aquifer through drive point wells and seepage meters, (2) groundwater sampling below the sediment surface using drive point wells, and (3) determination of physical lake characteristics such as depth, temperature, dissolved oxygen, pH, specific conductivity, and redox potential.

The lake's connection to the surficial aquifer will be analyzed by the use of drive point wells screened beneath lake sediment, and by seepage meters. Lake water elevation will be recorded using a staff gauge attached to a drive point well. This elevation will be compared to the groundwater elevation within the drive point well to determine whether or not the lake is draining or feeding the



surficial aquifer. A seepage meter will be utilized to measure the rate at which the lake is being fed or drained by the surficial aquifer. Proposed drive point wells and seepage meter placement locations are shown on Figure 3-2.

Drive point wells installed within the lake and screened below the sediment will be sampled for VOCs in the groundwater immediately below the lake's bottom. This will serve as an indicator as to whether and/or to what degree the groundwater is contributing to the VOC concentrations within the lake.

The following properties of the lake will be collected to refine the SCM:

- depth,
- temperature,
- dissolved oxygen,
- pH,
- specific conductivity, and
- redox potential.

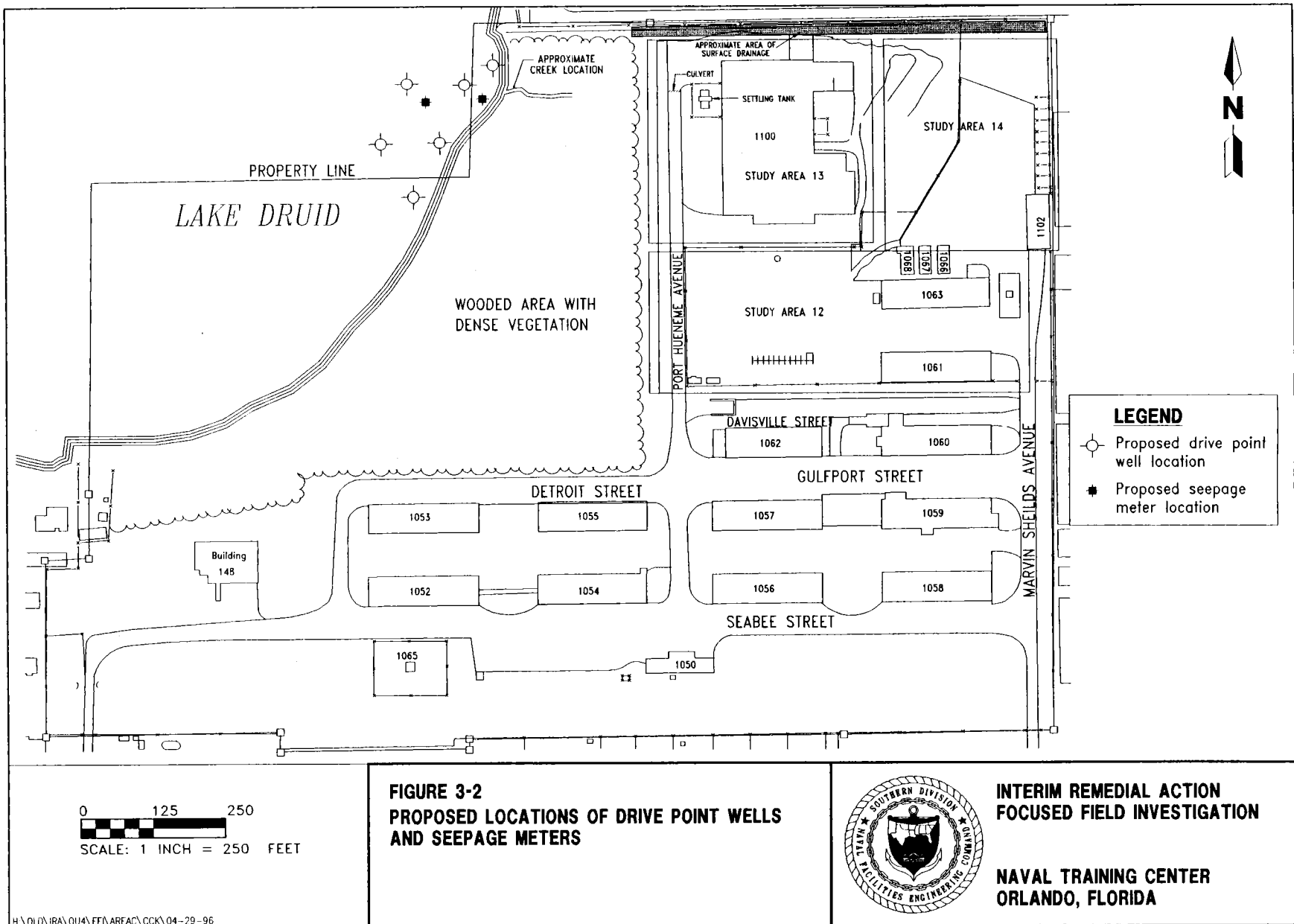
Samples will be collected within the lake at three different locations. The center of the lake will be one location for collecting properties, with the other two being at the discretion of the field team.

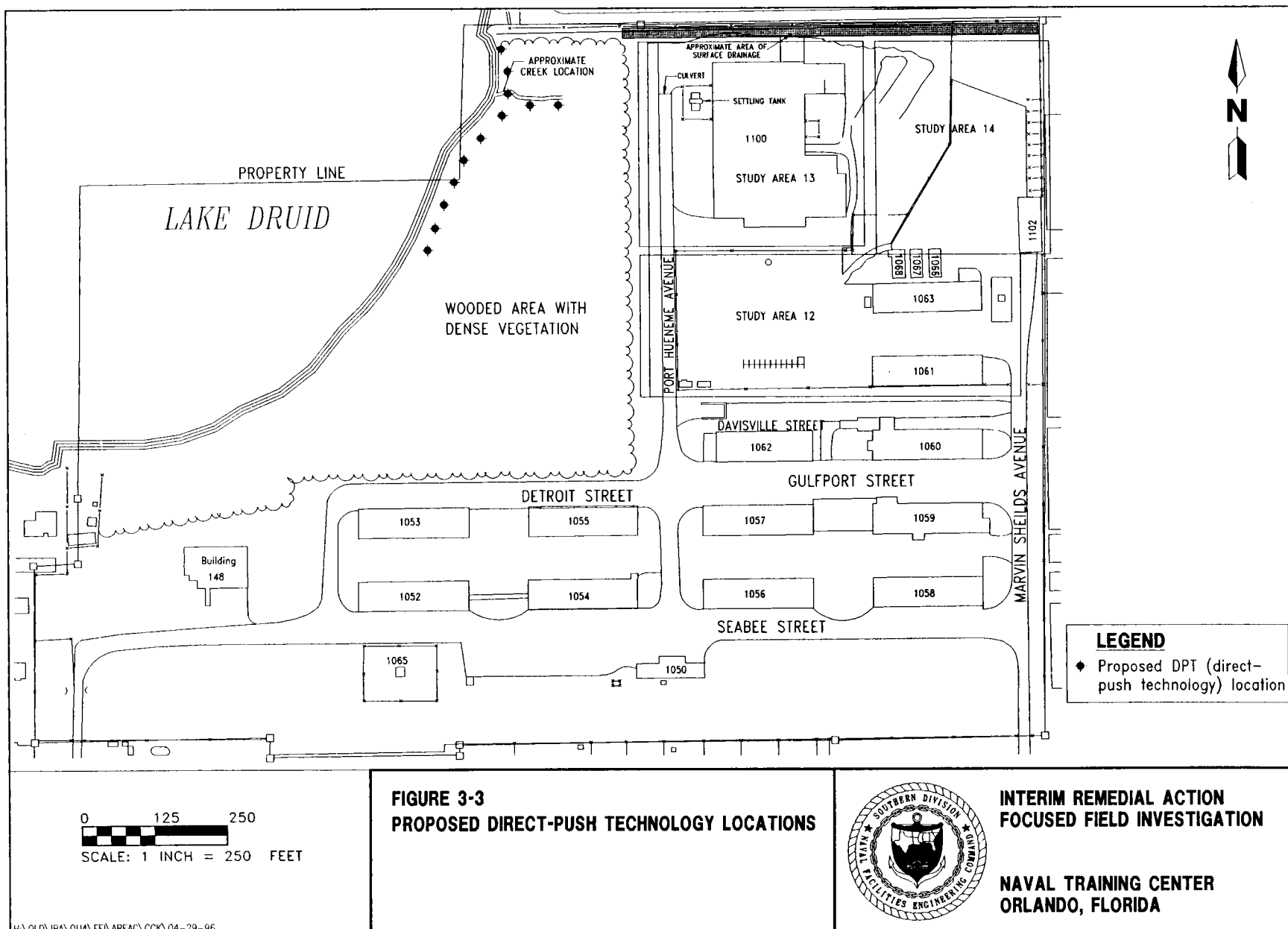
3.2.2.1 Direct-Push Technology (DPT) Sampling In order to collect field characterization quickly and with minimal disturbance to the ecology, DPT will be utilized along the lakeshore. DPT utilizes hydraulic pressure to force stainless steel rods into the subsurface at a constant rate. A larger DPT rig and a smaller TerraProbeSM will be utilized during the investigation. The larger rig is equipped with piezocones and hydrocones, which can be utilized if needed. The piezocone characterizes the penetrated soil, and the hydrocone collects groundwater samples from discrete depth intervals. Use of the TerraProbeSM will be limited to groundwater sample collection in the shallow part of the surficial aquifer. Ten DPT locations have been selected within 100 feet of the lakeshore (Figure 3-3) based on the results of the initial screening investigation. The 10 points will be placed parallel to the lakeshore at 40- to 50-foot spacing starting in the area of highest impact as demonstrated by the lake sediment and/or surface water results. Screening will continue until the horizontal and vertical limits of groundwater impact parallel to the lakeshore are delineated. Location selection of any additional DPT points will be left to the discretion of the project team and will be based on the results obtained at the first 10 points. Two DPT sample points will also be installed next to the creek as shown on Figure 3-3.

A detailed description of DPT methodology is presented in Section 4.4 of the POP.

Groundwater sample analyses will be performed with a mobile field laboratory using gas chromatography with purge and trap concentrator for trace level detection of selected VOCs as described and two analytical detectors in Subsection 3.3.1. The data obtained during these activities are considered Level II and will only be used to characterize hydrogeologic conditions in the study area.

3.2.3 Upgradient If the results of the lake and lakeshore investigations warrant the need, additional field investigation, including hydrocone and piezocone sampling, upgradient may be required to further characterize groundwater as a possible source of the contamination at this site.





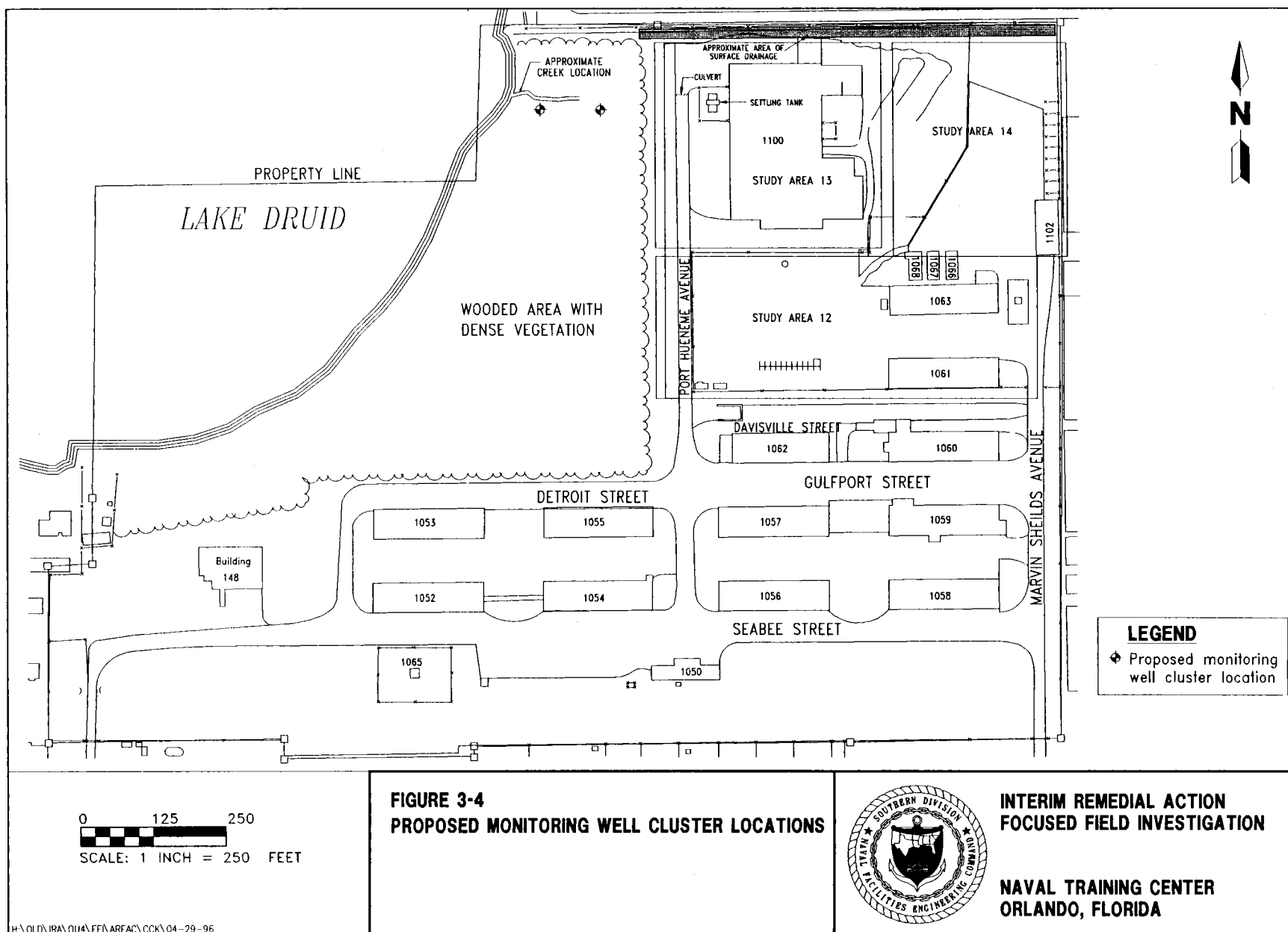
3.2.3.1 Monitoring Well Installation Installation involves the following four steps. (1) In order to confirm soil and groundwater quality and to measure the flow characteristics of the shallow aquifer, both into and away from the lake, monitoring wells may be installed in an area between the lake and the laundry. (2) It is anticipated that a minimum of six wells will be necessary to meet the objectives of the investigation. (3) The six wells will be placed within two clusters, with a shallow well screened to bracket the water table, a deep well screened at the base of the surficial aquifer, and an intermediate depth well screened at the interval that proves to be the most advantageous to meet the objectives of the study. (4) The cluster locations shown on Figure 3-4 are preliminary and will be finalized based on the results of the DPT investigation.

For this investigation, 6¼-inch inner diameter (ID) hollow-stem augers will be used to advance the hole to the desired depth. This will allow for the placement of an ample sand pack around the 2-inch-diameter well screen. Due to the nature of the contaminants of concern, all well material will be of 2-inch-diameter stainless steel. The monitoring wells will be installed by a licensed water well driller and in a fashion consistent with the guidelines set forth in the POP (Subsection 4.4.6, Exploratory Drilling). Each well will be developed upon installation to ensure proper contraction of the filter pack and the surrounding formation. All well installation and development activities will be done in a manner consistent with the guidelines prescribed in Section 4.4 of the POP.

In order to confirm the lithologic characterization suggested by the piezocone, subsurface soil samples will be collected at the deep well of each monitoring well cluster. The samples will be collected with a split-spoon sampler, which is driven into the subsurface by a 150-pound slide hammer attached to the drill rig. Samples will be collected continuously from the water table surface to the base of the surficial aquifer at each deep well location. Samples will be collected and analyzed for grain size, classified using the Unified Soil Classification System (USCS), and screened for VOC content with the onsite analytical equipment.

In order to aid in refining the SCM, groundwater samples will be collected from the permanent monitoring wells and sent to a laboratory for analysis. The wells will be purged and sampled in accordance with the guidelines set forth in Section 4.5 of the POP. Each sample will be analyzed for target compound list (TCL) organics. Samples will also be collected for determination of certain engineering treatability parameters. All field and laboratory QA/QC samples will be collected for analysis in accordance with Section 4.5 of the POP.

3.2.4 Aquifer Testing To evaluate hydraulic conductivity of the underlying aquifer, rising head aquifer slug tests will be performed on all the newly installed wells. The slug test data will be reduced, and the hydraulic conductivities calculated, using computer software which employs the Bower and Rice (1976) methodology for slug test analysis. In addition, hydraulic gradient at the site will be determined by collecting a minimum of three rounds of water levels in the existing wells and the new wells. Vertical and horizontal datum for the wells will be established by a licensed surveyor. The survey data will be referenced to either the base coordinate grid system or permanent fixtures at the site.



3.2.5 Treatability Study Based on the results of the field investigation and the laboratory analytical data results, a treatability study may be performed at Area C. The goal of the treatability study will be to evaluate the technical feasibility and obtain design criteria for a specific remedial technology. The treatability study may require a pumping test and an installation of one or two recovery wells or installation of additional monitoring wells.

3.2.6 Investigation-Derived Wastes (IDW) Management Plan The IDW generated during the IRA investigation will be handled and disposed of in a manner consistent with the POP. Every effort will be taken to minimize the volume of IDW generated. The IDW material will be generated as a result of waste associated with well installation (soil cuttings), well development and purging (groundwater, sediment, surface water), equipment decontamination (fluid residue), field laboratory, and personal protection and sample handling (personal protective equipment [PPE], plastic, etc.). All IDW will be placed into 55-gallon drums for storage. Each drum will be labeled as to its contents, point of origin, and date of generation. The storage containers will be covered with plastic sheeting to provide protection from the elements and placed at Building 1100 pending disposal. The storage containers will be segregated by origin and stored in such a manner as to facilitate easy inspection.

The laboratory analytical results on the various media will be used to determine the appropriate disposal method for the IDW. For any soil and sediment IDW, if no compounds or analytes are detected in excess of regulatory criteria then the material will be placed back on the ground surface near its point of origin. All analytical results for groundwater or surface water IDW will be provided to the authority of the local sanitary system who will make the determination of which drums of IDW can be disposed of through the sanitary system. Any drums that are rejected for elevated concentrations may be pretreated (i.e. filtering, aeration) if necessary in order to reduce the concentrations prior to disposal through the sanitary system. If treatment fails, then the OPT will approve a project-recommended disposal method. With regards to the containers of PPE and decontamination fluids, a sample will be collected from each container and analyzed with a portable GC in order to determine the volatile concentration. If rejected, then treatment will be utilized to reduce the volatile concentrations. If pretreatment fails, then the OPT will also approve the appropriate disposal method based on the project team recommendations. A record will be kept during the investigation detailing the history and eventual disposal of all IDW generated during the investigation.

3.3 SAMPLE ANALYSIS AND DATA MANAGEMENT. The following section describes the methods used to track and manage the environmental and QC data generated during the investigation.

3.3.1 Field Laboratory A field laboratory will be established to help determine the extent of contamination. Surface water, groundwater, sediment, and soil samples will be analyzed for VOCs by capillary gas chromatography. Target analytes shall include PCE, TCE, DCE, VC, and benzene, toluene, ethylbenzene, and xylenes (BTEX). Quantitation levels of 3 to 5 parts per billion (ppb) are suggested for this study and the analytical methods employed are designed to achieve them. These methods will be based on standard USEPA methods SW-846, 5030 (purge and trap preparation), 8000A (GC calibration), 8010A (halogenated volatile organics), and 8020 (BTEX) with modifications for field analysis.

The instrumentation used will be a Hewlett-Packard (HP) 5890 Series II GC equipped with a J&W Scientific DB-624, 0.53-mm-diameter capillary column (or equivalent) for compound separation. It will be fitted with a Tekmar purge and trap concentrator and two analytical detectors in series: a photoionization detector (PID) (for BTEX) and an electrolytic conductivity detector (ELCD) for chlorinated hydrocarbons. These detectors are very selective and sensitive to the target VOCs and should achieve sufficiently low quantitation limits for this study. Quantitation will be accomplished by means of HP Chemstation Chromatography software package provided with the GC.

3.3.1.1 Calibration Chemical standards will be obtained from Supelco, Inc., or an equivalent supplier. All standard preparation records will be logged and coded by the field chemist in the GC run logbook.

All stock standards will be prepared from neat compound standards or purchased chemical standard mixes. Working standards will be made by serial dilutions of stock standards in the appropriate solvent (i.e., purge and trap grade methanol). All appropriate standards will be preserved by storing them in a refrigerator or cooler.

Prior to analyzing samples, the instrument will be calibrated and instrument run conditions will be recorded in the GC run logbook. External calibration method is anticipated to be used as the primary method of analyte quantitation. USEPA method 8000A describes procedures to be used for the establishment of retention times and sample quantitation. A method detection limit (MDL) study should be completed prior to the start of sample analysis. This should consist of the preparation of seven replicates of a low-level standard in deionized (DI) water carried through the entire analytical procedure. The standard deviation is measured and multiplied by 3.14 to establish the specific MDL for each analyte. A practical quantitation limit (PQL) can then be estimated for each compound (generally a factor of 5 to 10 times the MDL, depending on the matrix). These will be recorded in the GC run logbook.

Initial calibration should consist of a three-to five-point calibration curve covering the desired range of interest for each analyte or the working linear range for the detectors. Quantitation of target VOCs may be calculated by a linear regression method, but is not required. If the relative standard deviation of the instrument response factors is less than 30 percent for an analyte, the average calibration factor may be used for quantitation. This will be accomplished by the field chemist's use of HP Chemstation Chromatography software provided with the GC.

Continuing calibrations will be run at the beginning and end of each day or analytical run and will consist of a mid-level standard of all target analytes. All compounds must have a percent difference of 30 percent or less when compared to the initial calibration. Sample analysis will only proceed if no more than one compound per detector exceeds this criterion. If this is not met, a second standard will be run. If this also fails, a new initial calibration must be run. Sample identifiers (I.D.s) for these standards will be recorded in the GC run logbook. The field chemist will review each sample analysis chromatogram before analyzing the next sample. Target compound retention times will be compared to calibration standards and carryover potential will be evaluated.

3.3.1.2 Sample Preparation All samples will be prepared in accordance with USEPA SW-846 5030 and ABB-ES's Standard Operating Procedures. This is a purge and trap procedure in which VOCs are purged from the sample in the purge chamber onto a tenax trap. Compounds are then desorbed from the trap into the GC for separation and analysis. For low-level soil samples, 5 grams of soil or sediment are added to the purge vessel and 5.0 milliliters (mL) of DI water are added before purging. For soil and sediment samples containing higher levels of VOCs, samples may be extracted with methanol prior to analysis. Concentrations in soil and sediment samples will be calculated based on the dry weight. Percent moisture adjustments will be made to the raw data results. Surface water and groundwater samples will be prepared using 5.0 mL of sample. Run conditions for the purge and trap sampling will be recorded in the GC run logbook.

3.3.2 Quality Assurance and Quality Control Samples QA/QC samples will be collected per the guidelines set forth in the POP.

3.3.2.1 Blanks Method blanks shall be run to ensure that sample preparation or other analytical procedures are not introducing target analytes. A method blank will be analyzed daily before any samples are analyzed. The blank results will be deemed acceptable if no target compounds exist above the PQL established for the method. Corrective action will be taken, if necessary, to eliminate any laboratory-introduced contamination. If acceptable method blank results cannot be achieved, then associated samples will be noted, and results will be flagged with a "B" to indicate blank contamination.

Instrument and/or cleaning blanks will consist of blank DI purge water run through the system and treated as a sample. They will be run at the discretion of the field chemist whenever a high-level sample is run to ensure that target analytes are not being introduced by the instrument itself and that no carryover from the column or trap is occurring.

Rinsate blanks and trip blanks will be collected and run as needed to ensure that cross-contamination of samples is not occurring due to sampling equipment or sample storage. These blanks should be demonstrated to be free of all target analytes.

3.3.2.2 Duplicate Samples Field duplicate samples will be run at a frequency of 10 percent to measure the precision of both field and lab procedures. USEPA data validation guidance suggests that the relative percent difference (RPD) between soil field duplicates generally should be within 50 percent and within 30 percent for aqueous samples. Laboratory duplicates will also be run and compared to the previously described RPD criteria to examine laboratory precision.

3.3.2.3 Matrix Spike and Matrix Spike Duplicates (MS/MSD) Selected samples will be fortified with a spiking solution of the target analytes and carried through the entire analytical procedure. Five percent of the field samples will be selected for MS/MSD per the POP guidelines. Percent recovery of these target compounds will be quantitated, evaluated by the field chemist, and results recorded in the GC run logbook.

3.3.2.4 Confirmatory Samples Approximately 10 percent of all field samples will be sent to an offsite certified laboratory for confirmatory analysis. Comparability will be based on agreement between the offsite and onsite lab results using the RPD guidelines of 30 percent for soils, 50 percent for soils.

3.3.2.5 Field Laboratory Documentation A log of all GC analyses will be recorded in a bound notebook with sequentially numbered pages. The logbook will record the concentrations for all calibration standards run, sample run number, sample I.D., date, standard preparation code, sample volume and/or weight, and any additional information particular to the sample run. After conclusion of the field effort, data will be processed by the data manager and provided for review. Raw data will include chromatograms, copies of the GC logbooks, and instrument calibration records from all standard, blank, and sample analyses used in the field program.

3.3.3 Data Review and Validation The field chemist will review each chromatogram before analyzing the next sample or batch of samples. The review will include calculation of surrogate standard recoveries, comparison of sample retention times to calibration standards for compound identification, and evaluation of potential sample carryover.

During the field program, field chemistry data will be reviewed by an independent ABB-ES project chemist to demonstrate compliance with the analytical criteria specified. Specifically, the data review process will include a review of:

- sample extraction and analysis dates, to determine if holding times were met;
- method blank data to assess any contamination introduced from the laboratory during handling and analysis;
- trip blank and rinsate blank data to assess possible contamination of VOCs introduced during sampling, transit, and storage;
- instrument calibration;
- field duplicate analyses in order to evaluate sampling and analytical precision;
- matrix spike data to evaluate analytical accuracy; and
- surrogate standard recoveries to evaluate analytical accuracy.

Corrections and appropriate data qualifiers will be added and incorporated into the final field data package.

3.3.4 Data Management Samples will be identified by using a sample label attached to the VOC sample container. Each sample label will be numbered to correspond with the appropriate sample(s) to be collected.

Samples collected for laboratory analysis during the field investigation will be labeled in accordance with the standard sample I.D. protocol described below.

The standard sample identifier consists of four fields, each containing a code. These fields, including their length in characters, are:

1. site identifier, 2 characters (alphanumeric, characters 1 and 2);
2. sample type, 1 character (alphabetic only, character 3);

3. sample location number, 3 characters (numeric only, characters 4 through 6); and
4. sequence or qualifier indicator, 2 characters (alphanumeric, characters 7 and 8).

A data dictionary for these fields follows.

1. Site identifier: an identifier for the largest area of interest within a base; for instance, a operable unit number, or a study area number.
2. Type of sample being taken, including information about media, matrix, and field quality control samples. Categories and codings are as follows:

H = groundwater, filtered	F = field blank
G = groundwater, unfiltered	T = trip blank
X = surface water, filtered	R = rinse blank
W = surface water, unfiltered	C = blind sample
S = surface soil	V = soil vapor
D = sediment	Z = other
Q = TerraProbe SM , water	
P = TerraProbe SM , soil and/or sediment	
N = Hydrocone, water	
Y = organic-free water source blank	

3. Sample location number within the site and matrix: This number would be unique within a site and matrix, i.e., the first surface water sample taken would be 001, the fifth groundwater sample would be 005, and the first soil boring would be 001. The last available sample location number is 999.
4. Sequence or qualifier indicator: a project-specific (but consistent within a project) indicator. The intended use is a sequential indicator of relative depth (or height) of a sample, relative to other samples of the same type at the same sample location, if appropriate. With this use, the sample closest to the land or water surface will be coded as 01; the sample that is ninth closest to the land or water surface will be coded as 09. Using this convention, if depth or height of sample has no meaning (plant tissue, for example), the sample may be coded as 00 (zero, zero).

Duplicates, matrix spikes, and matrix spike duplicates will be indicated by appending a "D," "MS," or "MSD" (respectively) to the end of this basic sample identifier.

3.4 DATA EVALUATION AND INTERPRETATION. Data for this project encompass both onsite and offsite laboratory analyses. Samples collected for offsite laboratory analysis will be used to confirm the analytical data collected in the onsite field laboratory. The data will be used to evaluate immediate risks to human health and to prepare the IRA report. The data will be collected and entered into a computer database for appropriate statistical analysis.

3.4.1 Data Evaluation, Interpretation, and Analysis The purpose of this task is to assess validated data results based upon data comparison to nonsite-related conditions. Results that meet the DQO requirements are considered usable. Results of the data evaluation will be documented in the RI report. The following data comparison and evaluations will be made:

- evaluation of detection limits,
- evaluation of counting errors,
- evaluation of equilibrium data,
- evaluation of qualified data,
- comparison of laboratory and field blanks with sample results, and
- comparison of laboratory and field duplicate results.

Contaminants of concern (COCs) will be identified through evaluation of the following criteria:

- Florida Surface Water Standards,
- Florida Drinking Water Standards, and
- frequency of detection

COCs will be used throughout the data evaluation, fate and transport assessment, the focused engineering evaluation, and as input to any future risk assessment conducted as part of the OU 4 RI/FS.

3.4.1.1 Nature and Extent The validated chemical data and the hydrogeologic data from this and previous investigations will be used to refine the SCM.

The size and depth of the contaminant plume(s) will be evaluated and represented graphically in plan and cross section. Geologic data from the piezocone and split-spoon sampling locations will be used to construct geologic cross sections and map any confining layers and any pathways for preferential migration of groundwater. Source evaluation of Lake Druid will be used to determine the lake's relation to groundwater and the contaminant plume.

3.4.1.2 Focused Engineering Evaluation Surface water screening and sampling will be conducted along the Lake Druid shore using DPT to roughly delineate the plume. The plume boundary may be further defined by additional upgradient sampling based on the lakeshore sampling results. ABB-ES will use a fate and transport assessment to evaluate for upgradient sources that might contribute to the plume and refine the conceptual model. The refined site conceptual model will be the basis for any interim remedial action.

4.0 INITIAL REMEDIAL INVESTIGATION REPORT

A draft IRA report will be prepared upon completion of the investigation. The report will include appropriate sections on site background, investigation activities, physical characteristics, nature and extent of contamination, and fate and transport. Numerical modeling may be used to evaluate the nature and extent and fate and transport of contaminants detected within the impacted area. If so, the U.S. Geological Survey in Altamonte Springs, Florida, will provide this capability. Probable conditions and reasonable deviations, as depicted in the current site conceptual model, will be verified and/or revised and presented in the report. The report will also contain conclusions and recommendations for follow-on actions that will aid in potential remedial technology selection.

After internal review, the document will be prepared for submission to the OPT members for review. A final IRA document will include a responsiveness summary based on comments received.

5.0 SCHEDULE

The fieldwork that has been described in this workplan will be accomplished in accordance with the schedule shown on Figure 5-1. This schedule is based on best conditions and may shift slightly if difficulties in the field are encountered such as weather problems, level C or higher PPE requirements, or equipment failure.

REFERENCES

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- ABB-ES, 1994b, Final Draft Environmental Baseline Survey (EBS) Report, NTC, Orlando, Florida: prepared for Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), Charleston, South Carolina.
- ABB-ES, 1995, Draft Site Screening Report, Groups I and II, NTC, Orlando, Florida: prepared for SOUTHNAVFACENGCOM, Charleston, South Carolina.
- Bouwer, H. and R.C. Rice, 1976, "A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells," *Water Resources Bulletin*, Volume 12, Number 3.
- Lichtler, W.F., Warren Anderson, and B.F. Joyner, 1968, Water Resources of Orange County, Florida: Florida Bureau of Geology Report of Investigation 50.

ATTACHMENT A

AREA C PRELIMINARY RISK EVALUATION

**AREA C PRELIMINARY
RISK EVALUATION**

**NAVAL TRAINING CENTER
ORLANDO, FLORIDA**

Unit Identification Code: N65928

Contract No.: N62467-89-D-0317/107

Prepared by:

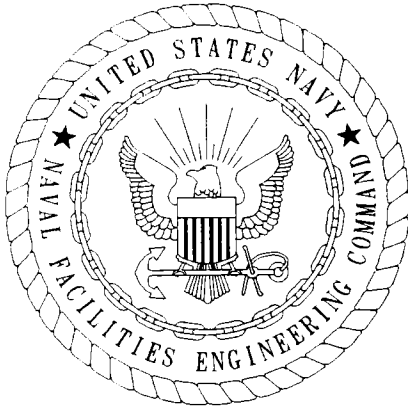
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Prepared for:

**Department of the Navy, Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
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Barbara Nwokike, Code 1873, Engineer-in-Charge

April 1996



CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

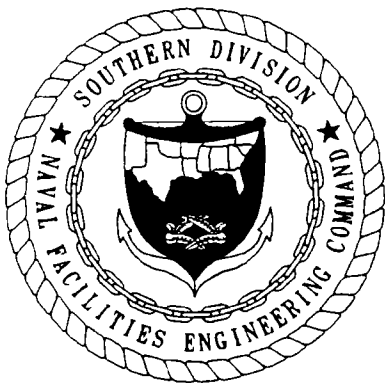
The Contractor, ABB Environmental Services, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/107 are complete and accurate and comply with all requirements of this contract.

DATE: April 30, 1996

NAME AND TITLE OF CERTIFYING OFFICIAL: John Kaiser
Task Order Manager

NAME AND TITLE OF CERTIFYING OFFICIAL: Mark Salvetti, P.E.
Project Technical Lead

(DFAR 252.227-7036)



FOREWORD

To meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and leaks and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at its facilities.

One of these programs is the Base Realignment and Closure (BRAC) cleanup program. This program complies with the BRAC Act of 1988 (Public Law (P.L.) 100-526, 102 Statute 2623) and the Defense Base Closure and Realignment Act of 1990 (P.L. 101-510, 104 Statute 1808), which require the DOD to observe pertinent environmental legal provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the 1992 Community Environmental Response Facilitation Act; Executive Order 12580; and the statutory provisions of the Defense Environmental Restoration Program, the National Environmental Policy Act (NEPA), and any other applicable statutes that protect natural and cultural resources.

CERCLA requirements, in conjunction with corrective action requirements under Subtitle C of the Resource Conservation and Recovery Act (RCRA), govern most environmental restoration activities. Requirements under Subtitles C, D, and I, of RCRA, as well as the Toxic Substances Control Act, the Clean Water Act, the Clean Air Act, the Safe Drinking Water Act, and other statutes, govern most environmental missions or operational-related and closure-related compliance activities. These compliance laws may also be applicable or relevant and appropriate requirements for selecting and implementing remedial actions under CERCLA. NEPA requirements govern the Environmental Impact Analysis and Environmental Impact Statement preparation for the disposal and reuse of BRAC installations.

The BRAC program centers on a single goal: expediting and improving environmental response actions to facilitate the disposal and reuse of a BRAC installation, while protecting human health and the environment.

The Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM); the U.S. Environmental Protection Agency; and the Florida Department of Environmental Protection collectively coordinate the cleanup activities through the BRAC cleanup team. This team approach is intended to foster partnering, accelerate the environmental cleanup process and expedite timely, cost-effective, and environmentally responsible disposal and reuse decisions.

Questions regarding the BRAC program at Naval Training Center, Orlando should be addressed to the SOUTHNAVFACENGCOM BRAC Environmental Coordinator, Mr. Wayne Hansel, Code 18B7, at (407) 646-5294 or SOUTHNAVFACENGCOM Engineer-in-Charge (EIC), Ms. Barbara Nwokike, Code 1873, at (803) 820-5566.

EXECUTIVE SUMMARY

ABB Environmental Services, Inc. (ABB-ES), under contract to the Southern Division, Naval Facilities Engineering Command, in accordance with Base Realignment and Closure (BRAC) 1993, has prepared this Preliminary Risk Evaluation (PRE) to characterize the potential risks to human health and the environment from environmental contamination associated with Area C at Naval Training Center (NTC), Orlando, Florida. The PREs are screening-level evaluations of potential risks that environmental contaminants associated with Area C may pose to human and ecological receptors. The PREs were performed to determine whether or not environmental contamination at Area C will require any future action, including but not limited to, additional site evaluations, a baseline risk assessment, remedial measures, or no further action.

The human health and ecological PREs were conducted in accordance with methodology provided in the U.S. Environmental Protection Agency (USEPA) Region IV Memorandum "Amended Guidance on Preliminary Risk Evaluations (PREs) for the Purpose of Reaching a Finding of Suitability to Lease (FOSL)" (USEPA, 1994a), and minutes of meetings with the USEPA and Florida Department of Environmental Protection (FDEP) concerning PREs (ABB-ES, 1995c). This methodology is designed to result in a conservative evaluation that does not overlook or dismiss potentially substantial risks. The PRE is most useful in determining risks that are not significant, rather than determining the specific nature and magnitude of risks associated with the site.

In accordance with this methodology, the public health PRE was conducted by comparing maximum detected analyte concentrations in groundwater, surface water, sediment, surface soil, subsurface soil, and estimated indoor air concentrations of volatile organic compounds (VOCs), to regulatory criteria and readily available risk screening values based on potential exposures to residential populations. These evaluations were expressed as risk estimates and were compared to the USEPA target cancer risk range of 1×10^{-6} to 1×10^{-4} and the noncancer hazard index (HI) value of 1.

The results of the public health risk assessment indicate that, based on available information, potential residential exposures to groundwater used as source of drinking water may pose cancer and noncancer risks above USEPA acceptable risk levels, and maximum groundwater concentrations of chlorinated VOCs, arsenic, and beryllium exceed State and Federal regulatory criteria. In addition, under current land-use conditions, a potential may exist for VOC vapor migration from groundwater and subsurface soil to ambient air in aboveground residential structures. Potential cancer risks for residential inhalation exposures to estimated indoor VOC concentrations are within USEPA acceptable risk limits, but are above 1×10^{-6} . Cancer and noncancer risk estimates for potential residential direct-contact exposures to surface soil and subsurface soil, and potential residential swimming exposures to surface water and sediment in Lake Druid, are within USEPA acceptable risk limits. However, cancer risk estimates for surface water are above 1×10^{-6} , and maximum concentrations of arsenic, tetrachloroethylene, and beryllium in soils exceed State regulatory criteria.

The ecological PRE was conducted by comparing maximum detected analyte concentrations in surface water and sediment to State and Federal standards and maximum surface soil concentrations to soil screening values developed by ABB-ES.

Through these comparisons, analytes which were detected at maximum concentrations above the screening values were identified. The results of the ecological PRE suggest that it is unlikely that the populations of aquatic receptors occurring in Lake Druid, and terrestrial plant, invertebrate, and vertebrate receptors potentially exposed to Area C surface soils would be adversely affected by contamination associated with Area C.

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Naval Training Center
Orlando, Florida

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
AWQC	Federal Ambient Water Quality Criteria
bls	below land surface
BRAC	Base Realignment and Closure
CF	conversion factor
cm	centimeter
DCE	dichloroethene
DRMO	Defense Reutilization Materials Office
EBS	Environmental Baseline Survey
ELCR	excess lifetime cancer risk
FDEP	Florida Department of Environmental Protection
FOSL	Finding of Suitability to Lease
GC	gas chromatograph
HI	hazard index
HQ	hazard quotient
ℓ/day	liters per day
MADEP	Massachusetts Department of Environmental Protection
MCL	maximum contaminant level
MEK	methyl-ethyl ketone
m ³	cubic meter
μg/kg	micrograms per kilogram
μg/ℓ	microgram per liter
mg/day	milligrams per day
mg/kg	milligram per kilogram
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NTC	Naval Training Center
OPT	Orlando Partnering Team
PCE	Tetrachloroethene
PCL	Protective Contaminant Levels

GLOSSARY (Continued)

PRE	preliminary risk evaluation
RBC	risk-based concentrations
SCG	soil cleanup goal
SQC	sediment quality criteria
SQGs	sediment quality guidelines
SWSV	surface water screening values
TCE	trichloroethene
TPH	total petroleum hydrocarbon
UCL	upper confidence limit
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1.0 INTRODUCTION

This document presents Public Health and Ecological Preliminary Risk Evaluations (PREs) for Area C at the Naval Training Center (NTC) in Orlando, Florida. Soil and groundwater contamination (primarily chlorinated solvents) was discovered during site screening activities at the former laundry (Study Area 13) and the adjacent Study Areas 12 and 14 (ABB Environmental Services, Inc. [ABB-ES], 1995a).

1.1 BACKGROUND AND CONDITIONS. The following is a brief summary of Study Areas 12, 13, and 14. More detailed descriptions can be found in the Final Site Screening Plan, Groups I Through V Study Areas and Miscellaneous Sites (ABB-ES, 1995b).

1.1.1 Study Area 12 Study Area 12 includes the Defense Reutilization Materials Office (DRMO) warehouses and salvage yard (Building 1063), and the truck scales (Building 1069). These buildings are located on Port Hueneme Avenue, in the northcentral portion of Area C, south of the laundry (Study Area 13). The warehouse building was originally constructed in the early 1940s. Site use has reportedly remained consistent (i.e., salvage, scrap, and disposal yard) throughout its history. Based on review of aerial photographs, the original structure occupied approximately one-half the footprint of the current structure. The current warehouse is constructed of sheet-metal walls and roof (i.e., a Butler building) on concrete slab. This structure was added to, or replaced, the original warehouse in 1962. The asphalt paved salvage yard, located west of the warehouse, is occupied by rows of salvage scrap materials, concrete storage bins, and a drum storage area. There is also a transformer carcass storage area in the southwest corner of the study area. Salvage scrap items are also stored in this area, including desks, wheels, vehicles, transformers, and fencing. It is not known how long this area has been paved.

Historical records indicate this area was used to store small quantities (1 to 5 gallons) of hazardous waste between 1959 and 1985. These wastes were stored in the southwest corner of the salvage lot and included the following: paints, insecticides, asbestos, solvents including trichloroethene (TCE) and methyl-ethyl ketone, ammonium hydroxide, sodium sulfide, and mercury.

1.1.2 Study Area 13 Study Area 13 includes the NTC laundry facility (Building 1100) and the former location of a boiler house (Building 1101). Study Area 13 is located in the northwest corner of Area C at Port Hueneme Avenue and Davisville Street. Building 1101 was located east of Building 1100 and was demolished sometime after 1962.

Building 1100 was constructed in 1943, and is a single-story, wood-framed structure that had always been used as an industrial laundry and drycleaning facility, which served the entire military base. The surrounding property is paved asphalt, except for small areas east and west of the building that are landscaped and grass covered. The paved areas around the perimeter of the building include roads and parking lots. Prior to construction of the facility in 1943, the land was undeveloped. The laundry was closed in 1995.

Reportedly, hazardous wastes generated and materials used in the drycleaning process had been poorly managed. At the time of the environmental baseline survey

(ABB-ES, 1994), there were many containers in the building, ranging in volume from ½ to 55 gallons that were open and not labeled. The facility had received a Notice of Violation and a citation from the Florida Department of Environmental Protection (FDEP) for unlabeled and unmanifested waste.

Wastewater from the laundry machines discharged to the sanitary sewer through badly deteriorated drainage trenches in the floor. The floor trenches discharge to a single pipe that is connected to a settling-and-surge tank. Due to the volume of water discharged in this area, a 30,000-gallon surge tank was installed in the mid-1960s. Sludge was removed from this tank annually and disposed of through the DRMO. Waste filters from the drycleaning machines were also generated at the facility. Tetrachloroethene (PCE) was separated from the water and filters by heating the assemblies in a pressure cooker. The filters were disposed of through the DRMO, and the solvent was recycled. In the past, the filters were allegedly disposed of in the North Grinder Landfill (ABB-ES, 1994).

Documented discharges of water contaminated with chlorinated solvents have occurred on the property. Discharges of water from the washing machines to Lake Druid have also been documented.

1.1.3 Study Area 14 Study Area 14 includes Building 1102 and the surrounding paved and grassed areas. The facility is located off Marvin Shields Avenue in the northwest portion of Area C, west of the laundry (Study Area 13). The facilities are used for indoor and outdoor storage of salvageable equipment and materials, in support of DRMO operations. The facility includes a rectangular, one-story, corrugated-steel building constructed on a concrete slab with a gabled roof. The surrounding salvage yard is currently asphalt paved. The building was originally constructed in 1969. Prior to that time, the area between the base laundry (to the northwest) and the current structure was used as a scrap and salvage yard. Equipment and materials currently stored at this location include office furniture, mattresses, refrigerators, and drycleaning equipment.

There is documentation of a release of three gallons of PCE from scrap drycleaning equipment in 1989. Remediation included the removal and disposal of approximately 20 drums of contaminated soil and asphalt. However, the exact location of the release was not indicated (ABB-ES, 1994).

1.2 INVESTIGATION SUMMARY. The site-screening investigation conducted at Area C included a soil-gas survey, surface and subsurface soil sampling, and the installation of 16 monitoring wells to evaluate groundwater. Twelve wells were installed to evaluate the shallow surficial aquifer (approximately 15 to 20 feet below land surface [bls]). Four wells in the immediate vicinity of the laundry were screened at the base of the surficial aquifer, approximately 60 feet bls. Saturated soil samples were collected approximately every 6 feet from the interval between the shallow and deep wells and analyzed on a field gas chromatograph (GC). Combined with the groundwater samples collected from the monitoring wells, these data contributed to the evaluation of the surficial aquifer.

The results of the site screening investigation are provided in detail in the Draft Site Screening Report for Groups I and II (ABB-ES, 1995a). Volatile organic detections are summarized on Figure 1-1. PCE and TCE were detected above the Florida Maximum Contaminant Level (MCL) of 3 micrograms per liter ($\mu\text{g}/\text{l}$) in several shallow monitoring wells. The highest concentrations of each compound

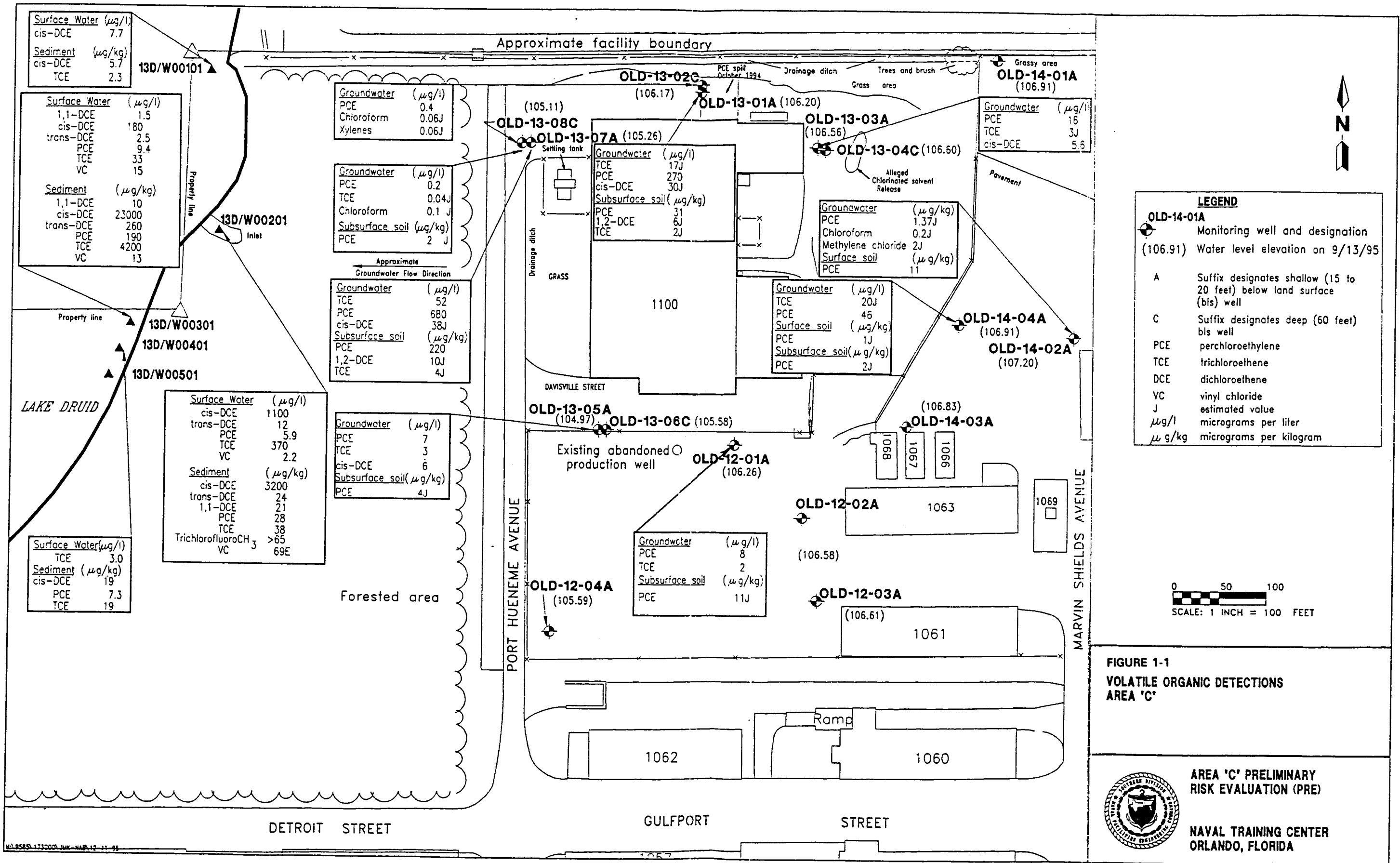
were detected in shallow monitoring well OLD-13-07A, located west of the laundry. PCE and TCE were also detected in the deep well OLD-13-08C, but at concentrations below the MCL. Field GC data for soils collected in this vicinity detected PCE and TCE in soil approximately 18 feet bls at concentrations of 3,700 micrograms per kilogram ($\mu\text{g}/\text{kg}$) and 1,300 $\mu\text{g}/\text{kg}$, respectively.

Lake Druid was not included in the original site screening investigation. After reviewing the site-screening data, the Orlando Partnering Team (OPT) requested that surface water and sediment samples be collected from the lake.

On November 29, 1995, surface water and sediment samples were collected along the shoreline of Lake Druid. These samples were analyzed by an offsite laboratory by U.S. Environmental Protection Agency (USEPA) Method 8010. These results are also summarized on Figure 1-1. PCE, TCE, cis-1,2-dichloroethene (cis-DCE), 1,1-DCE, and vinyl chloride were detected at these locations. At some locations, TCE and cis-DCE were detected in surface water at concentrations greater than had been detected in groundwater collected from the monitoring wells. Vinyl chloride and 1,1-DCE had not been detected in groundwater.

On December 11, 1995, additional surface water and sediment samples were collected in Lake Druid approximately 50 feet west of the locations shown on Figure 1-1. The water depth was approximately 4 feet. Cis-DCE was detected in surface water collected from each deeper location. TCE was also detected in surface water opposite sample location 13D/W00201. TCE and PCE were detected in sediment from this deeper location, and from the location 50 feet west of sample 13W/D00301. Chlorinated solvent concentrations from the locations farther out in the lake were generally much lower than at the shoreline, sometimes by two orders of magnitude.

The PRE for Area C was conducted using the data outlined above.



2.0 PRELIMINARY RISK EVALUATION

The PREs are screening-level evaluations of potential risks that environmental analytes may pose to human and ecological receptors. The results of the PREs are used in conjunction with other information gathered during site screening to focus future site activities.

The specific objectives of the PRE are to:

- review the existing analytical data collected for surface soil, subsurface soil, surface water, sediment, and groundwater;
- characterize the current and potential future land uses and ecological status of each site to identify potential human and ecological receptors and contaminant exposure pathways;
- compare the analytical data to available human health and ecological screening guidelines and criteria to identify chemicals that may be associated with risks of concern;
- identify data gaps and make recommendations for future actions.

Specifically, the PREs at NTC, Orlando, Area C were conducted to aid in determining whether or not additional remedial investigations are needed at this site.

This chapter provides a brief summary of the methodology used to conduct the Public Health and Ecological PREs (Section 2.1), results of the Public Health and Ecological PREs (Section 2.2), and conclusions of the PREs (Section 2.3).

2.1 PRELIMINARY RISK EVALUATION METHODOLOGY. The human health and ecological PREs are generally consistent with methodology provided in the USEPA Region IV memorandum "Amended Guidance on Preliminary Risk Evaluations (PREs) for the Purpose of Reaching a Finding of Suitability to Lease (FOSL)" (USEPA, 1994a), and minutes of meetings with USEPA and FDEP concerning PREs (ABB-ES, 1995c).

In summary, the PREs provide an evaluation of the primary exposure pathways that might be expected to contribute substantially to potential human and ecological risks associated with exposures to analytes in various media at the site. The PREs are conducted by comparing maximum detected analyte concentrations with background concentrations and readily available risk screening values. This methodology is designed to result in a conservative evaluation that does not overlook or dismiss potentially substantial risks. The PRE is most useful in determining risks that are not significant, rather than determining the nature and magnitude of risks associated with the site.

The technical approaches used for the public health and ecological PREs are described below in Subsections 2.1.1 and 2.1.2, respectively.

2.1.1 Public Health PRE The public health PRE is conducted by comparing maximum detected analyte concentrations in groundwater, surface water, sediment, surface soil (soil collected 0-2 feet bls), and subsurface soil (soil collected 2 to 10

feet bls), in addition to estimated indoor air concentrations of volatile organic compounds (VOCs), with readily available screening values including the following:

- risk-based concentrations (RBCs) published by USEPA Region III (USEPA, 1995a) (all media except surface water)
- Federal MCLs (USEPA, 1995b) (groundwater only)
- FDEP guidance concentrations (FDEP, 1994) (groundwater only)
- FDEP soil cleanup goals for military sites (FDEP, 1995) (soils only).
- surface water screening values (SWSVs) developed by ABB-ES (Appendix B)

Comparisons to RBCs and SWSVs are expressed through a risk ratio. For analytes with maximum concentrations above the background concentration, risk-ratios are calculated by dividing the maximum detected analyte concentration by the RBC or SWSV. Separate risk ratios are calculated for carcinogenic and noncarcinogenic effects. Summary risk ratios for carcinogenic and noncarcinogenic effects are then calculated by summing the cancer risk ratios for all carcinogenic analytes, and the noncancer risk ratios for noncarcinogenic analytes, respectively.

For groundwater, maximum detected groundwater concentrations are also compared directly to MCLs and FDEP criteria. Any analytes with maximum concentrations that exceed these values are identified. In addition, because the potential may exist for VOCs in groundwater and subsurface soil to volatilize and accumulate in structures located on the ground surface above, potential exposures to indoor air were estimated using a VOC migration model (Farmer Model) (Appendix C). The estimated indoor air concentrations were then compared with RBCs for ambient air. Risk ratios are not calculated for the comparison to regulatory criteria.

USEPA Region III RBCs are based on toxicity constants and standard exposure scenarios and correspond to fixed levels of risk. For noncarcinogenic chemicals, the RBC is based on a hazard quotient (HQ) of 1. For carcinogenic chemicals the RBC is based on a lifetime cancer risk of 1×10^{-6} . The standard exposure scenarios (residential and industrial) for which RBCs have been developed include the inhalation of ambient air and the ingestion of tapwater, fish tissue, and soil. For groundwater at Area C, RBCs for tapwater are used for risk screening of potential direct contact exposures. Indirect exposures to groundwater VOCs, which may volatilize to aboveground structures, are evaluated with RBCs for ambient air. For surface soils, subsurface soils, and sediments, RBCs for residential soil are used. RBCs for tapwater exposures are calculated assuming that children (age 1-6 years) and adults ingest 1 liter or 2 liters per day (L/day) of groundwater that has been used as drinking water, respectively, 350 days per year for a combined total of 30 years. RBCs for ambient air use the same exposure parameters for tapwater exposure, substituting inhalation rates of 12 cubic meters (m^3) (child) and 20 m^3 per day (adult) for water ingestion rates. RBCs for residential soil exposures are calculated assuming that children (age 1-6 years) and adults ingest 200 or 100 milligrams per day of soil, respectively, 350 days per year for a combined total of 30 years. Dermal and inhalation exposures are not considered in the calculation of RBCs.

For noncarcinogenic analytes, a risk-ratio above 1 indicates that the maximum detected analyte concentration exceeds the RBC and, therefore, exceeds a HQ of

1. A noncancer summary risk ratio above 1 indicates that additive exposures to the maximum detected concentrations of all noncarcinogenic analytes exceed a hazard index (HI) of 1. An HI less than 1 indicates that noncarcinogenic toxic effects are unlikely. HIs greater than 1 indicate non-carcinogenic risk associated with potential exposures may be of concern. As the HI increases, so does the likelihood that adverse effects might be associated with exposure. However, HI values greater than 1 should be interpreted with caution, since the toxicities of all analytes are not necessarily additive. The acceptable risk level for noncarcinogenic effects is generally an HI of 1 or less (USEPA, 1989), although values greater than 1 may also be acceptable.

For carcinogenic analytes, a risk ratio above 1 indicates that the maximum detected analyte concentration exceeds the RBC and, therefore, potential exposures may be associated with excess lifetime cancer risk greater than 1×10^{-6} . A cancer summary risk ratio above 1 indicates that additive exposures to the maximum detected concentrations of all carcinogenic analytes may be associated with an excess lifetime cancer risk (ELCR) greater than 1×10^{-6} . The USEPA guidelines, established in the National Oil and Hazardous Substances Contingency Plan (NCP), indicate that the allowable total lifetime cancer risk due to exposure to the analytes at a site, by each complete exposure pathway, is within a range of 1 in 1 million (1×10^{-6}) to 1 in 10,000 (1×10^{-4}) (USEPA, 1990). These criteria are generally based on exposure to a conservative estimate of the average concentrations of analytes.

Because Lake Druid surface water is not used as a source of drinking water, comparisons of surface water data with screening values developed for potential drinking water exposures are not appropriate. Therefore, surface water screening values based on potential swimming exposures were developed by ABB-ES to evaluate surface water data. Health-based SWSVs were developed using risk assessment methodology consistent with USEPA guidance. SWSVs were developed for a child (age 1-6) and adult resident that are assumed to be exposed to surface water through incidental ingestion and dermal contact for 2.6 hours per day, 45 days per year, for 30 years. Using the ratio method described below, SWSVs were calculated for the surface water concentrations associated with 1×10^{-6} excess lifetime cancer risk with an HI of 1. The risk assessment spreadsheets, including documentation of exposure parameters and presentation of SWSV calculations, are provided in Appendix B.

$$\frac{\text{Surface water Risk}}{\text{Surface water Concentration}} = \frac{\text{Target Risk}}{\text{SWSV}} \quad (1)$$

where: Surface water risk is the ELCR or HI calculated in the risk spreadsheets (Appendix B), and
Target Risk is ELCR = 1×10^{-6} or HI = 1

For each analyte, the lower of the calculated screening concentrations for cancer or noncancer risk was selected as the final SWSV.

2.1.2 Ecological PRE The ecological PRE is conducted by comparing the maximum concentrations of analytes detected in surface water, sediment, and surface soil (soil collected 0-2 feet bls) with readily available screening values. Since ecological receptors are typically not exposed to subsurface soils (soils

collected deeper than 2 feet), this medium is not evaluated in the ecological PRE. Likewise, ecological receptors do not have direct contact exposures to groundwater and, therefore, this medium is not evaluated.

The ecological PRE for surface water is conducted by comparing maximum detected concentrations of analytes in surface water with surface water screening values based on water quality criteria for the protection of aquatic organisms. The ecological PRE for sediment is conducted by comparing maximum detected concentrations of analytes in sediment with sediment screening values based on sediment quality criteria for the protection of aquatic organisms. The ecological PRE for surface soil is conducted by comparing the maximum detected concentrations of analytes in surface soil with surface soil screening values developed to protect terrestrial vertebrate receptors, plants, and invertebrates. For all media, analytes that are detected at maximum concentrations above the background concentrations and above the screening values are identified.

Surface water screening values include the following:

- Federal Ambient Water Quality Criteria (USEPA, 1986),
- USEPA Region IV Chronic Freshwater Quality Screening Values (USEPA, 1994b), and
- Florida Class III Fresh Water Standards (Florida Administrative Code, Chapter 62-302, 1995).

Sediment screening values include the following:

- Sediment Quality Criteria (SQC) for the protection of Benthic Organisms (USEPA, 1988)
- USEPA Region IV Sediment Screening Values for Hazardous Waste Sites (USEPA, 1994c)
- Florida Sediment Quality Guidelines (SQG) (MacDonald, 1994)
- Ontario Ministry of Environment SQG; lowest effect levels (Persaud et al., 1992).

The lesser of the surface water and sediment screening values provided by each of these sources are used as the aquatic screening values to evaluate surface water and sediment data at Area C.

USEPA Region IV does not specify a methodology for assessing surface soil exposures to ecological receptors (USEPA, 1994a), and no State or Federal standards or guidelines exist for surface soil exposure. Therefore, this exposure pathway is evaluated through comparison of maximum analyte concentrations in surface soil with Protective Contaminant Levels (PCLs) for terrestrial vertebrate receptors (calculated by ABB-ES), phytotoxicity benchmark values for plants (Hill and Suter, 1994; Hulzebos et al., 1993), and invertebrate toxicity benchmark values for terrestrial invertebrates (Neuhauser, 1985; and others). This method of evaluation has been reviewed by the U.S. Army, Massachusetts Department of Environmental Protection, regulators in USEPA Regions I and IV, and the FDEP.

The PCL value is calculated using a food-web model, which assumes that terrestrial vertebrate receptors could be exposed to analytes in surface soil through incidental surface soil ingestion and food-chain uptake (e.g., ingestion of plants and invertebrates exposed to the soil). PCLs are calculated for receptors that could potentially occur at Area C, including the short-tailed shrew, the white-footed mouse, and the American Robin. The lowest PCL value for these three receptors is selected as the screening value to evaluate surface soil data. This value is expected to be protective of the population of terrestrial vertebrate receptors that could potentially be exposed to the surface soil at Area C.

2.2 PRELIMINARY RISK EVALUATION RESULTS. The results of the human health PRE are presented in Appendix A, Tables A-1 through A-5, and discussed in Subsection 2.2.1. The results of the ecological PRE are presented in Appendix A, Tables A-5 through A-8, and discussed in Subsection 2.2.2.

2.2.1 Human Health Preliminary Risk Evaluation This PRE identifies potential risks that may be associated with current and potential future exposures to groundwater associated with Area C, surface soil, and subsurface soil collected at Area C, and surface water and sediment collected at Lake Druid. Sample locations for these media are presented on Figure 1-1.

Although not part of Area C, a small area of Lake Druid adjacent to Area C was sampled (Figure 1-1). Data collected during the site investigation suggest that groundwater associated with Area C may be discharging to Lake Druid, located approximately 300 feet downgradient of the site. Analytical data for surface water and sediment samples collected in the vicinity of the potential groundwater discharge area substantiate site-screening results. Therefore, surface water and sediment samples collected in this portion of Lake Druid are included in the PRE.

Under current land use, there are no direct contact exposures to surface soil and subsurface soil, since samples were collected from beneath a paved area and there are no excavation activities presently occurring which could result in potential exposures. Groundwater associated with Area C is not used as a source of residential or industrial water and, therefore, there are no direct contact exposures. However, because the depth to groundwater is relatively shallow (i.e., approximately 6 feet), there may be potential for volatile contaminants in the groundwater to volatilize into aboveground structures; exposures to contaminated air could potentially occur. As discussed above, surface water is not used as a source of drinking water. Swimming is unlikely in the area of Lake Druid that was sampled because the area abuts U.S. Navy property, is not readily accessible to residents living on the lake, and does not present an attractive place for swimming (e.g., the area appeared "stagnant" and filled with aquatic vegetation). However, to provide a conservative evaluation of risks associated with potential exposures to surface water and sediment, swimming exposures were evaluated.

Under future land use, it is assumed that groundwater associated with this site could be used as a source of residential drinking water; exposures could occur through ingestion, dermal contact, and inhalation of volatiles. If the pavement was removed, surface soils could be made accessible for direct contact exposures (i.e., incidental ingestion, dermal contact, and inhalation of dust and vapors). If construction activities were to take place, subsurface soils could be re-located to the surface; direct contact exposures could occur through incidental ingestion, dermal uptake, and inhalation of vapors and dust.

Groundwater. Appendix A, Table A-1 presents the results of the human health PRE for groundwater. The summary cancer risk ratio is 1,300. This indicates that additive potential exposures to the maximum detected concentrations of carcinogenic analytes in groundwater might be associated with an excess lifetime cancer risk as high as 1×10^{-3} (1 in 1,000). The analytes contributing the largest percentage to the cancer risk ratio include tetrachloroethylene and arsenic. Risk ratios for these analytes are 620 and 610, respectively, which correspond to estimated cancer risks of 6×10^{-4} for each analyte. The maximum detected concentrations of trichloroethene and beryllium also exceed RBCs by factors of more than 10, corresponding to estimated cancer risks between 1×10^{-5} and 1×10^{-4} . Maximum detected concentrations of tetrachloroethylene, trichloroethene, and bis(2-ethylhexyl)phthalate also exceed Federal MCLs and FDEP guidance concentrations.

The summary noncancer risk ratio for groundwater is 5.6 (Appendix A, Table A-1). The individual risk ratios contributed by arsenic (2.5) and antimony (1.2) account for approximately one-half of the summary noncancer risk ratio. The maximum detected concentration of antimony exceeds the MCL and the FDEP guidance concentration. The maximum detected concentrations of aluminum and iron exceed secondary MCLs, which are promulgated for aesthetic or economic reasons (not health-based), and FDEP guidance concentrations. The maximum detected concentration of sodium exceeds the Federal health advisory and the FDEP guidance concentration.

The PRE for potential exposures to estimated indoor air VOC concentrations is presented in Appendix C. Of the three VOCs detected in well OLD-13-01A (which is the well adjacent to the abutting residential property), estimated indoor air concentrations of two VOCs (tetrachloroethylene and trichloroethene) exceed RBCs for ambient air. The summary cancer risk ratio is 66, with ratios for tetrachloroethylene and trichloroethene of 58 and 8.3, respectively. These ratios correspond to estimated cancer risks of 6×10^{-5} and 8×10^{-6} , respectively. The summary noncancer risk ratio is less than 1.

Surface Water. Appendix A, Table A-2 presents the public health PRE for surface water. The summary cancer risk ratio is 28. This indicates that additive potential exposures to the maximum detected concentrations of carcinogenic analytes in surface water might be associated with an excess lifetime cancer risk as high as 3×10^{-5} (3 in 10,000). The analyte contributing the largest percentage to the cancer risk ratio is vinyl chloride. The risk ratio for this analyte is 19, which corresponds to estimated cancer risks of 2×10^{-5} .

The summary noncancer risk ratio for surface water is 0.3 (Appendix A, Table A-2). The majority of this risk is contributed by cis-1,2-dichloroethene, which was detected at a maximum concentration of 1,100 $\mu\text{g}/\ell$.

Sediment. Appendix A, Table A-3 presents the public health PRE for sediment. The summary cancer risk ratio is 0.31. This indicates that additive potential exposures to the maximum detected concentrations of carcinogenic analytes in sediment might be associated with an excess lifetime cancer risk as high as 3×10^{-7} . The analyte contributing the largest percentage to the cancer risk ratio is vinyl chloride, with a cancer risk ratio of 0.2 (corresponding to an estimated cancer risk of 2×10^{-7}).

The summary noncancer risk ratio for sediment is 0.03 (Appendix A, Table A-3). The majority of this risk is contributed by cis-1,2-dichloroethene, which was detected at a maximum concentration of 23,000 mg/kg.

Surface Soil. Appendix A, Table A-4 presents the public health PRE for surface soil. The summary cancer risk ratio is 1.4. This indicates that additive potential exposures to the maximum detected concentrations of carcinogenic analytes in surface soil may be associated with excess lifetime cancer risk as high as 1×10^{-6} . No analytes are associated with individual cancer risk ratios above 1. Only arsenic was detected at a maximum concentration above the Florida Soil Cleanup Goals (SCGs). However, the maximum detected concentration is below the background concentration.

The summary noncancer risk ratio for surface soil is 0.38 (Appendix A, Table A-2). The maximum detected concentration of arsenic exceeds the SCG, but is below the background concentration.

Subsurface Soil. Appendix A, Table A-5 presents the results of the human health PRE for subsurface soil. The summary cancer risk ratio is 11. This indicates that additive potential exposures to the maximum detected concentrations of carcinogenic analytes in subsurface soil may be associated with excess lifetime cancer risk as high as 1×10^{-5} . The analytes contributing the largest percentage to the cancer risk ratio include arsenic, beryllium, and Aroclor-1260. Risk ratios for these analytes are 6, 3.3, and 1.3, respectively, which correspond to estimated cancer risks between 1×10^{-6} and 1×10^{-5} for each analyte. The maximum detected concentration of tetrachloroethylene exceeds the leaching SCG.

The summary noncancer risk ratio for subsurface soil is 2.3 (Appendix A, Table A-3). The individual risk ratio contributed by total petroleum hydrocarbons (TPH) (1.6) accounts for the majority of the summary noncancer risk ratio. The screening value for TPH is not an RBC, but rather a risk-based screening value developed by ABB-ES for potential exposures to gasoline in soil. Since volatile compounds typically associated with gasoline, which are more toxic than heavier petroleum compounds, were not detected in the subsurface soil at this site, this screening value is conservative for this site.

There are several sources of uncertainty associated with the human health PRE that should be kept in mind when interpreting the results. Among those that may influence the results most substantially are described below.

- No evaluation of potential groundwater direct-contact inhalation exposures: Tapwater RBCs account for ingestion intakes only, and do not address additional exposures that may occur to VOCs through inhalation and dermal contact during bathing or dishwashing activities. Although ingestion exposures often represent a greater percentage of the total exposure, not evaluating potential inhalation exposures from groundwater results in underestimation of potential risk for volatile compounds.
- Estimated indoor-air concentrations: Indoor-air concentrations were estimated to provide a preliminary evaluation of the potential exposures that might occur if VOCs in groundwater and subsurface soil migrated as vapor and accumulated in overlying structures, specifically the residences adjacent to Area C. For this reason, groundwater VOC concentrations detected in well OLD-13-01A were used to estimate

potential indoor air concentrations. This well was selected to represent groundwater concentrations because it is located closest to the residences and, lacking more sufficient data, provides the best estimate of potential concentrations associated with this exposure pathway. However, it is unknown whether or not VOC contamination is present under the residential area. This, in addition to several other variables such as potential VOC concentration in groundwater, depth to groundwater, soil moisture and porosity, and building construction details, lends considerable uncertainty to this evaluation.

- Potential exposures to surface water and sediment in Lake Druid: Exposures to Lake Druid surface water were evaluated for potential swimming activities by a resident living on the lake. Evaluation of this exposure scenario represents a conservative approach because it is based on activities that would result in a reasonable maximum exposure to surface water. Potential exposures to surface water from fishing and boating activities would be considerably lower, as VOCs do not substantially accumulate in fish tissue, and inhalation exposures to VOCs in surface water and sediment would be lower than surface water ingestion and dermal contact exposures. However, risks for these potential exposures would be additive to risks for swimming exposures.
- Evaluation of the maximum detected analyte concentration: Developing summary risk estimates using maximum detected analyte concentrations provides a conservative evaluation, as it is unlikely that a receptor would be simultaneously exposed to all sample locations associated with maximum detected concentrations. Evaluation of the average concentration or 95th percent upper confidence limit (UCL) on the arithmetic mean concentration results in lower and more realistic risk estimates.
- No evaluation of potential noncancer risks from exposures to carcinogenic analytes: With the exception of arsenic, published RBCs are based on either a noncancer or cancer endpoint, depending upon which basis results in a lower (more protective) RBC; chemicals with RBCs based on a cancer endpoint are not included in the noncancer risk evaluation. Because all chemicals have an inherent noncancer (systemic) toxicity, excluding carcinogenic chemicals from the noncancer risk evaluation results in an underestimation of potential noncancer risk.
- Relative contribution of background to the risk estimate: For some inorganic analytes such as arsenic and beryllium, background concentrations exceed RBCs. The background groundwater arsenic concentration, for example, contributes approximately 18 percent of the estimated risk. This suggests that estimated risks for these analytes are not entirely attributable to site-related contamination.

2.2.2 Ecological Preliminary Risk Evaluation This PRE identifies potential risks that may be associated with exposures to surface soils collected at Area C and surface water and sediment collected at Lake Druid. Sample locations for these media are presented on Figure 1-1.

Data collected during the site investigation suggest that groundwater associated with Area C may be discharging to Lake Druid, located approximately 300 feet downgradient of the site. Analytical data for surface water and sediment samples

collected in the vicinity of a potential discharge area substantiate site-screening results (Figure 1-1). Therefore, although the portion of Lake Druid adjacent to Area C is not considered part of Area C, it is included in this PRE to determine if contamination potentially associated with Area C poses a risk to aquatic receptors.

Surface soils were collected from an area that is presently covered by pavement. Therefore, terrestrial vertebrate, plant, and invertebrate receptors are not currently exposed to surface soils at Area C. The surface soil risk evaluation provides an estimate of potential risks that may be present if the pavement in this area was to be removed in the future, allowing for direct contact with the soils.

Surface Water. Appendix A, Table A-6 presents the results of the ecological PRE for surface water. Of the six chlorinated VOCs detected in surface water, only the maximum detected concentration of trichloroethene exceeds the surface water screening value. Maximum concentrations of four other VOCs do not exceed screening values, and a screening value is not available for vinyl chloride.

Sediment. Appendix A, Table A-7 presents the results of the ecological PRE for sediment. No screening values are available for any of the six chlorinated VOCs detected in sediment. Therefore, data reported for sediment cannot be directly evaluated. A method of indirectly evaluating potential sediment impacts is discussed below.

The presumed source of the VOCs in surface water and sediment is groundwater, which discharges through the sediments and into the surface water of the lake. As groundwater discharges, some amount of each contaminant may sorb to sediment particulates, while the rest remains free in the pores between sediment particulates (i.e., the sediment porewater). The fraction of contaminant within the sediment porewater is generally considered to be more bioavailable than the fraction that is sorbed to sediments (USEPA, 1988). If it is assumed that all of the contaminants in groundwater are contained within the porewater (i.e., that none are sorbed to the sediment particulates), then groundwater concentrations may be representative of sediment porewater concentrations. Comparing these estimated sediment porewater concentrations to screening criteria provides an estimate of potential risks to aquatic organisms in sediments at the point of groundwater discharge.

A comparison of maximum groundwater concentrations (presented previously in Appendix A, Table A-1) with surface water screening values (presented in Appendix A, Table A-6) indicates that of the three VOCs detected in both groundwater and sediment (cis-1,2-dichloroethene, tetrachloroethylene, and trichloroethene), only the maximum detected groundwater concentration of tetrachloroethylene (680 $\mu\text{g/L}$) exceeds the surface water screening value (84 $\mu\text{g/L}$). However, this evaluation does not consider potential exposures to porewater concentrations of 1,1-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride. These VOCs, which may result from chlorinated ethene degradation, were detected in sediment but not in groundwater and, therefore, the potential porewater concentrations are unknown.

Surface Soil. Appendix A, Table A-8 presents the results of the ecological PRE for surface soil. No organic analytes were detected at maximum concentrations above terrestrial PCL, plant, or invertebrate screening values. No inorganic analytes were detected at maximum concentrations above PCL values. Plant

screening values are exceeded by the maximum detected concentrations of aluminum, chromium, and zinc. The maximum concentration of copper exceeds the invertebrate screening value.

The screening values for aluminum, copper, and zinc are exceeded by factors of less than two, whereas the chromium screening value is exceeded by a factor of four. However, plant screening values for aluminum and chromium are based on background soil concentrations because the published literature-based screening values are below the soil background concentrations for Area C. Plants that may occur in the vicinity of this site would not be adversely affected by background concentrations of these inorganic analytes. Although the concentrations at which phytotoxicity may occur are unknown, it is unlikely that plants would be adversely affected by exposures to concentrations slightly above background. Likewise, it is unlikely that plant and invertebrate exposures to zinc and copper concentrations, respectively, that are slightly above the screening values would adversely affect plants and invertebrates.

2.3 PRELIMINARY RISK EVALUATION CONCLUSIONS. Conclusions of the public health and ecological PREs are presented below.

- Under current land-use conditions, a potential may exist for VOC vapor migration from groundwater and subsurface soil to ambient air in above-ground residential structures. Potential cancer risks based on estimated indoor air concentrations for a theoretical structure located on the Area C boundary adjacent to the residential area are within the USEPA acceptable cancer risk limits, but are greater than 1×10^{-6} . However, additional data are required to determine the nature and extent of potential groundwater and subsurface soil contamination in the vicinity of the residential property.
- Potential human receptor exposures to tetrachloroethylene, trichloroethene, arsenic, and beryllium in groundwater used as a residential source of water may pose cancer and noncancer risks above USEPA acceptable risk levels.
- Maximum detected concentrations of tetrachloroethylene, trichloroethene, and arsenic in groundwater, arsenic in surface soil, and tetrachloroethylene, arsenic, and beryllium in subsurface soil exceed Federal and State regulatory criteria.
- Based on available sampling and analytical data, potential exposures to VOC contamination in surface water and sediment from recreational swimming do not pose cancer and noncancer risks above USEPA acceptable risk levels. Cancer risks associated with potential surface water exposures are greater than 1×10^{-6} . However, these risk estimates do not consider additive exposures from other surface water and sediment exposure pathways that could potentially exist.
- It is unlikely that the populations of terrestrial vertebrate, plant, and soil invertebrate receptors would be adversely impacted by potential future exposures to surface soils at Area C.

- It is unlikely that the populations of aquatic receptors occurring in Lake Druid would be adversely impacted by potential exposures to VOCs in surface water and sediment in the area of suspected discharge. However, potential risks associated with sediment exposures could only be qualitatively evaluated, and this represents an uncertainty.
- The human health and ecological PREs for surface water and sediment are limited. Surface water and sediment sampling in Lake Druid was confined to an area of suspected groundwater discharge, and samples were analyzed for chlorinated VOCs only. Risks were evaluated for the data available and, therefore, are representative of potential exposures to a limited number of analytes in a defined area of the lake. The potential presence of contamination in other areas of Lake Druid has not been well characterized. Although supplemental samples collected at locations approximately 50 feet further into the lake from the original sampling points contained substantially lower concentrations of chlorinated VOCs (i.e., less than 50 parts per billion), the characteristics of groundwater discharge into Lake Druid have not been fully established. Risks associated with other areas of potential groundwater discharge and other chemicals have not been evaluated.
- There are no human or ecological receptor direct contact exposures to groundwater and subsurface soil at Area C under current land-use conditions.

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APPENDIX A

PRELIMINARY RISK EVALUATION TABLES

TABLE A-1
Human Health Preliminary Risk Evaluation of Groundwater ¹

Area "C"
Naval Training Center
Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	USEPA Region III RBC ⁴	Risk Ratio ⁵	Federal MCL ⁶	Maximum Exceeds Federal MCL ⁷	FDEP Guidance Concentration ⁷	Maximum Exceeds Guid. Conc. ⁷
CARCINOGENIC EFFECTS										
VOLATILES (µg/L)										
Chloroform	3 / 18	0.2	ND	YES	0.15	1.3	100	NO	6	NO
Methylene chloride	1 / 18	2	ND	YES	4.1	0.49	5	NO	5	NO
Tetrachloroethylene	11 / 18	680	ND	YES	1.1	618	5	YES	3	YES
Trichloroethene	9 / 18	52	ND	YES	1.6	33	5	YES	3	YES
SEMIVOLATILES (µg/L)										
Bis(2 – Ethylhexyl) phthalate	3 / 18	33	ND	YES	4.8	6.9	6	YES	6	YES
INORGANICS (µg/L)										
Arsenic	8 / 18	27.6	5	YES	0.045	613	50	NO	50	NO
Beryllium	7 / 18	1.1	ND	YES	0.016	69	4	NO	4	NO
SUMMARY CANCER RISK RATIO:						1300				
NON – CARCINOGENIC EFFECTS										
VOLATILES (µg/L)										
1,2 – Dichloroethene (cis)	5 / 18	38	ND	YES	61	0.62	70	NO	70	NO
Xylene (total)	1 / 18	0.06	ND	YES	12,000	0.0000050	10,000	NO	10000	NO
SEMIVOLATILES (µg/L)										
Dimethylphthalate	1 / 18	1	ND	YES	370,000	0.0000027	NA	NA	70000	NO
Phenol	1 / 18	1	ND	YES	22,000	0.000045	NA	NA	10	NO
INORGANICS (µg/L)										
Aluminum	15 / 18	17300	4067	YES	37,000	0.47	200	YES	200	YES
Antimony	4 / 18	17.6	4.1	YES	15	1.17	6	YES	6	YES
Arsenic	8 / 18	27.6	5	YES	11	2.51	50	NO	50	NO
Barium	18 / 18	145	31.4	YES	2,600	0.056	2,000	NO	2000	NO
Cadmium	1 / 18	3.2	5.6	NO	18	NE	5	NO	5	NO
Calcium	18 / 18	125000	36830	YES	1,055,398	0.12	NA	NA	NA	NA
Chromium	2 / 18	20.8	7.8	YES	180	0.12	100	NO	100	NO
Copper	1 / 18	47.9	5.4	YES	1,500	0.032	1,300	NO	1000	NO
Iron	18 / 18	2010	1227	YES	11,000	0.18	300	YES	300	YES
Lead	1 / 18	2.1	4	NO	15	NE	15	NO	15	NO
Magnesium	18 / 18	5030	4560	YES	118,807	0.042	NA	NA	NA	NA
Manganese	18 / 18	32.8	17	YES	180	0.18	50	NO	50	NO
Mercury	3 / 18	0.14	0.12	YES	11	0.013	2	NO	2	NO
Potassium	18 / 18	3730	5400	NO	297,016	NE	NA	NA	NA	NA
Selenium	3 / 18	5.5	9.7	NO	180	NE	50	NO	50	NO
Silver	2 / 18	3.6	ND	YES	180	0.020	100	NO	100	NO
Sodium	18 / 18	41600	18222	YES	396,022	0.11	20,000	YES	160000	NO
Vanadium	12 / 18	16.9	20.6	NO	260	NE	NA	NA	49	NO
Zinc	10 / 18	24.4	4	YES	11,000	0.002	5,000	NO	5000	NO
WATER QUALITY PARAMETERS (mg/L)										
Total Suspended Solids	2 / 6	108	ND	YES	NA	NA	NA	NA	NA	NA
SUMMARY NON – CANCER RISK RATIO:						5.6				

TABLE A-1
Human Health Preliminary Risk Evaluation of Groundwater ¹

Area "C"
Naval Training Center
Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	USEPA Region III RBC ⁴	Risk Ratio ⁵	Federal MCL ⁶	Maximum Exceeds Federal MCL ⁷	FDEP Guidance Concentration ⁷	Maximum Exceeds Guid. Conc. ⁷
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NOTES:

¹ Based on analytical data for the following sample identifiers: 12G00101 TO 12G00401, 13G00101 TO 13G00801 (duplicate at 13G00101), 14G00101 TO 14G00401, 1400G302 (duplicate at 14G00401)

² Frequency of Detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples.

³ The background screening value is twice the average of detected concentrations for inorganic analytes. For organic analytes, values are the mean of detected concentrations, presented for comparison purposes only.

⁴ Values are from USEPA Region III RBC table, October 20, 1995 (USEPA, 1995).

RBCs are for tap water and are based on a hazard quotient of 1 or an excess lifetime cancer risk of 1 in 1 million.

Arsenic is evaluated as a carcinogen and a non-carcinogen.

Value for chromium based on chromium VI.

Values for essential nutrients (calcium, magnesium, potassium, and sodium) are based on Recommended Daily Allowances (RDAs), and are derived by ABB-ES.

RBC is not available for lead; value is the treatment technique action limit for lead in drinking water distribution systems identified in the

Drinking Water Standards and Health Advisories (USEPA, 1995).

Value for mercury based on inorganic mercury.

⁵ The risk ratio is equal to the maximum detected analyte concentration divided by the USEPA Region III RBC. Risk ratios are calculated for analytes with a maximum detected concentration greater than the background concentration.

A summary cancer risk ratio of 1 roughly corresponds to excess lifetime cancer risk of 1×10^{-6} ; a summary non-cancer risk ratio of 1 roughly corresponds to a hazard index of 1. These ratios tend to overestimate risks, since they are based on maximum detected concentrations.

⁶ Federal MCL published in Drinking Water Regulations and Health Advisories, May 1995 (USEPA, 1995).

Current MCLs listed for bromodichloromethane and chloroform. 1994 Proposed rule for disinfectants and disinfection byproducts: total for all trihalomethanes combined cannot exceed 80 ppm.

Value for aluminum is a secondary MCL and represents the upper limit of the range (50 – 200 µg/L).

Value for copper is the treatment technique action level; the secondary MCL is 1000 µg/L.

Value for iron is a secondary MCL.

Value for lead is the action level triggering treatment techniques.

Value for manganese is a secondary MCL.

Value for silver is a secondary MCL and a lifetime health advisory.

Value for sodium is a health advisory guideline value.

Value for zinc is a lifetime health advisory; the secondary MCL is 5000 µg/L.

⁷ Florida Department of Environmental Protection Groundwater Standards, June 1994.

⁸ FDEP Primary Standard

⁹ FDEP Guidance Concentration

NA = Not Available/Not Applicable

ND = Not Detected

NE = Not Evaluated

TABLE A-2
Human Health Preliminary Risk Evaluation of Surface Water ¹

Area "C"
 Naval Training Center
 Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	SWSV ⁴	Risk Ratio ⁵
CARCINOGENIC EFFECTS						
VOLATILES (µg/L)						
1,1-Dichloroethene	1 / 5	1.9	ND	YES	1.3	1.5
Tetrachloroethylene	2 / 5	9.4	ND	YES	4.7	2
Trichloroethene	3 / 5	370	ND	YES	64.9	5.70
Vinyl chloride	2 / 5	15	ND	YES	0.8	19
SUMMARY CANCER RISK RATIO:						28
NON-CARCINOGENIC EFFECTS						
VOLATILES (µg/L)						
1,2-Dichloroethene (cis)	3 / 5	1100	ND	YES	3667	0.30
1,2-Dichloroethene (trans)	2 / 5	12	ND	YES	3750	0.0032
SUMMARY NON-CANCER RISK RATIO:						0.30

NOTES:

¹ Based on analytical data from the following sampling locations: 13W/D00101 to 13W/D00501.

² Frequency of Detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples.

³ The background screening value is twice the average of detected concentrations for inorganic analytes. For organic analytes, values are the mean of detected concentrations, presented for comparison purposes only.

⁴ Values have been calculated by ABB-ES in accordance with USEPA Region IV risk assessment guidance, and are based on child and adult resident ingestion and dermal contact exposures to surface water during swimming. Screening values are based on a target cancer risk of 1×10^{-6} or a target HI of 1, and were calculated using the following equality: $[(\text{Maximum surface water concentration}) / (\text{Total resident cancer risk (or child HI for non-cancer risk)})] = [(\text{Screening value}) / (\text{Target risk})]$
 Screening values are presented in Table A-4.

⁵ The risk ratio is equal to the maximum detected analyte concentration divided by the screening value. Risk ratios are calculated for analytes with a maximum detected concentration greater than the background concentration.
 A summary cancer risk ratio of 1 roughly corresponds to excess lifetime cancer risk of 1×10^{-6} ; a summary non-cancer risk ratio of 1 roughly corresponds to a hazard index of 1. These ratios tend to overestimate risks, since they are based on maximum detected concentrations.

NA = Not Available/Not Applicable

ND = Not Detected

TABLE A-3
Human Health Preliminary Risk Evaluation of Sediment ¹

Area "C"
Naval Training Center
Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	USEPA Region III RBC ⁴	Risk Ratio ⁵
CARCINOGENIC EFFECTS						
VOLATILES (mg/Kg)						
1,1 - Dichloroethene	2 / 5	0.021	ND	YES	1.1	0.019
Tetrachloroethylene	3 / 5	0.19	ND	YES	12	0.0158
Trichloroethene	4 / 5	4.2	ND	YES	58	0.07
Vinyl chloride	2 / 5	0.069	ND	YES	0.34	0.20
SUMMARY CANCER RISK RATIO:						0.31
NON - CARCINOGENIC EFFECTS						
VOLATILES (mg/Kg)						
1,2 - Dichloroethene (cis)	4 / 5	23	ND	YES	780	0.029
1,2 - Dichloroethene (trans)	2 / 5	0.26	ND	YES	1600	0.00016
SUMMARY NON - CANCER RISK RATIO:						0.030

NOTES:

¹ Based on analytical data from the following sampling locations: 13W/D00101 to 13W/D00501.

² Frequency of Detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples.

³ The background screening value is twice the average of detected concentrations for inorganic analytes. For organic analytes, values are the mean of detected concentrations, presented for comparison purposes only.

⁴ Values are from USEPA Region III RBC table, October 20, 1995 (USEPA, 1995).

RBCs are for residential soil and are based on a hazard quotient of 1 or an excess lifetime cancer risk of 1 in 1 million.

⁵ The risk ratio is equal to the maximum detected analyte concentration divided by the USEPA Region III RBC. Risk ratios are calculated for analytes with a maximum detected concentration greater than the background concentration.

A summary cancer risk ratio of 1 roughly corresponds to excess lifetime cancer risk of 1×10^{-6} ; a summary non-cancer risk ratio of 1 roughly corresponds to a hazard index of 1. These ratios tend to overestimate risks, since they are based on maximum detected concentrations.

NA = Not Available/Not Applicable

ND = Not Detected

NE = Not Evaluated

TABLE A-4
Human Health Preliminary Risk Evaluation of Surface Soil ¹

Area "C"
 Naval Training Center
 Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	USEPA Region III RBC ⁴	Risk Ratio ⁵	FDEP SCG ⁶	Maximum Exceeds SCG ?
CARCINOGENIC EFFECTS								
VOLATILE ORGANIC COMPOUNDS (mg/kg)								
Tetrachloroethylene	3 / 10	0.011	ND	YES	12	0.00092	⁷ 0.03	NO
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)								
Benzo (a) anthracene	1 / 10	0.11	ND	YES	0.88	0.13	1.4	NO
Benzo (b) fluoranthene	1 / 10	0.22	ND	YES	0.88	0.25	1.4	NO
Benzo (k) fluoranthene	1 / 10	0.18	ND	YES	8.8	0.020	14	NO
Chrysene	1 / 10	0.2	ND	YES	88	0.0023	140	NO
Indeno (1,2,3-cd) pyrene	1 / 10	0.14	ND	YES	0.88	0.16	1.4	NO
PESTICIDES/PCBs (mg/kg)								
4,4'-DDE	2 / 10	0.0058	ND	YES	1.9	0.0031	3	NO
4,4'-DDT	3 / 10	0.017	ND	YES	1.9	0.0089	3.1	NO
Chlordane-alpha	1 / 10	0.0018	ND	YES	0.49	0.0037	0.8	NO
Chlordane-gamma	1 / 10	0.0016	ND	YES	0.49	0.0033	0.8	NO
INORGANICS (mg/kg)								
Arsenic	4 / 10	0.84	1	NO	0.43	NE	0.7	YES
Beryllium	2 / 10	0.13	0.09	YES	0.15	0.87	0.2	NO
SUMMARY CANCER RISK RATIO:						1.4		
NON-CARCINOGENIC EFFECTS								
VOLATILE ORGANIC COMPOUNDS (mg/kg)								
Acetone	2 / 10	0.042	ND	YES	7,800	0.0000054	260	NO
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)								
Benzo (g,h,i) perylene	1 / 10	0.18	ND	YES	2,300	0.000078	14	NO
Pyrene	1 / 10	0.23	ND	YES	2,300	0.00010	2200	NO
INORGANICS (mg/kg)								
Aluminum	10 / 10	2180	2088	YES	78,000	0.028	75000	NO
Arsenic	4 / 10	0.84	1	NO	23	NE	0.7	YES
Barium	10 / 10	5.8	8.7	NO	5,500	NE	5200	NO
Cadmium	1 / 10	1.7	0.98	YES	39	0.044	37	NO
Continued on next page.								

TABLE A-4
Human Health Preliminary Risk Evaluation of Surface Soil ¹

Area "C"
Naval Training Center
Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	USEPA Region III RBC ⁴	Risk Ratio ⁵	FDEP SCG ⁶	Maximum Exceeds SCG ?
Calcium	10 / 10	12400	25295	NO	1,000,000	NE	NA	NA
Chromium	9 / 10	16.4	4.6	YES	390	0.042	290	NO
Copper	3 / 10	30.2	4.1	YES	3,100	0.0097	NA	NA
Iron	8 / 10	660	712	NO	460,468	NE	NA	NA
Lead	8 / 10	40.9	14.5	YES	400	0.10	500	NO
Magnesium	10 / 10	175	328	NO	460,468	NE	NA	NA
Manganese	9 / 10	14.7	8.1	YES	390	0.038	370	NO
Mercury	1 / 10	0.07	0.07	NO	23	NE	23	NO
Nickel	3 / 10	9.2	4.4	YES	1,600	0.0058	1500	NO
Vanadium	6 / 10	2.5	3.1	NO	550	NE	490	NO
Zinc	6 / 10	52.9	17.2	YES	23,000	0.0023	23000	NO
TOTAL PETROLEUM HYDROCARBONS (mg/kg)								
Total Petroleum Hydrocarbons	8 / 10	40.2	ND	YES	380	0.11	NA	NA
SUMMARY NON-CANCER RISK RATIO:						0.38		

- NOTES:**
- ¹ Based on analytical data for the following sample identifiers: 12B00101 to 12B00401 (duplicate at 12B00401), 14B00101 to 14B00401, and 13B00501.
- ² Frequency of Detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples.
- ³ The background screening value is twice the average of detected concentrations for inorganic analytes. For organic analytes, values are the mean of detected concentrations, presented for comparison purposes only.
- ⁴ Values are from USEPA Region III RBC table, October 20, 1995 (USEPA, 1995). RBCs are for residential soil and are based on a hazard quotient of 1 or an excess lifetime cancer risk of 1 in 1 million.
Value for benzo(g,h,i)perylene based on value for pyrene as a conservative surrogate.
Arsenic is evaluated as a carcinogen and a non-carcinogen.
Value for chromium based on hexavalent chromium.
RBC is not available for lead; value is from Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER Directive 9355.4-12).
Value for mercury is based on inorganic mercury.
Value for nickel based on nickel soluble salts.
RBC is not available for TPH. Values are screening values for gasoline derived by ABB-ES.
- ⁵ The risk ratio is equal to the maximum detected analyte concentration divided by the USEPA Region III RBC. Risk ratios are calculated for analytes with a maximum detected concentration greater than the background concentration.
A summary cancer risk ratio of 1 roughly corresponds to excess lifetime cancer risk of 1×10^{-6} ; a summary non-cancer risk ratio of 1 roughly corresponds to a hazard index of 1. These ratios tend to overestimate risks, since they are based on maximum detected concentrations.
- ⁶ Florida Department of Environmental Protection Soil Cleanup Goals for Military Sites in Florida (FDEP, September 29, 1995). Values presented are for Residential.
Value for chromium based on chromium VI.
- ⁷ Value is the leaching-based value. This analyte was detected in groundwater at a maximum concentration above the FDEP Guidance Concentration.
- NA = Not Available/Not Applicable
ND = Not Detected
NE = Not Evaluated. The maximum detected concentration is less than background.

TABLE A-5
Human Health Preliminary Risk Evaluation of Subsurface Soil ¹

Area "C"
Naval Training Center
Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	USEPA Region III RBC ⁵	Risk Ratio ⁵	FDEP SCG ⁶	Maximum Exceeds SCG?
CARCINOGENIC EFFECTS								
VOLATILE ORGANIC COMPOUNDS (mg/kg)								
Tetrachloroethylene	4 / 17	0.031	ND	YES	12	0.0026	7 0.03	YES
Trichloroethene	1 / 17	0.002	ND	YES	58	0.000034	0.01	NO
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)								
Benzo (a) anthracene	2 / 17	0.11	ND	YES	0.88	0.13	1.4	NO
Benzo (b) fluoranthene	2 / 17	0.17	ND	YES	0.88	0.19	1.4	NO
Benzo (k) fluoranthene	1 / 17	0.13	ND	YES	8.8	0.015	14	NO
Chrysene	3 / 17	0.16	ND	YES	88	0.0018	140	NO
PESTICIDES/PCBs (mg/kg)								
4,4'-DDD	3 / 17	0.0099	ND	YES	2.7	0.0037	0.2	NO
4,4'-DDE	5 / 17	0.032	0.0392	NO	1.9	0.017	0.2	NO
4,4'-DDT	2 / 17	0.1	ND	YES	1.9	0.053	0.5	NO
Aroclor-1260	1 / 17	0.11	ND	YES	0.083	1.3	44	NO
BHC-alpha	1 / 17	0.0061	ND	YES	0.1	0.061	0.2	NO
Chlordane-alpha	1 / 17	0.0046	ND	YES	0.49	0.0094	2.1	NO
Chlordane-gamma	1 / 17	0.0044	ND	YES	0.49	0.0090	2.1	NO
INORGANICS (mg/kg)								
Arsenic	11 / 17	2.6	1.1	YES	0.43	6.0	NA	NA
Beryllium	6 / 17	0.49	ND	YES	0.15	3.3	NA	NA
SUMMARY CANCER RISK RATIO:						11		
NON-CARCINOGENIC EFFECTS								
VOLATILE ORGANIC COMPOUNDS (mg/kg)								
1,2-Dichloroethene (total)	1 / 17	0.006	ND	YES	700	0.0000086	0.2	NO
2-Butanone	1 / 17	0.004	ND	YES	47,000	0.00000085	8.7	NO
Acetone	9 / 17	0.13	ND	YES	7,800	0.000017	1.4	NO
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)								
Benzo (g,h,i) perylene	2 / 17	0.12	ND	YES	2,300	0.000052	320	NO
Fluoranthene	3 / 17	0.26	ND	YES	3,100	0.000084	280	NO
Pyrene	3 / 17	0.2	ND	YES	2,300	0.000087	290	NO
Continued on next page								

TABLE A-5
Human Health Preliminary Risk Evaluation of Subsurface Soil ¹

Area "C"
Naval Training Center
Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	USEPA Region III RBC ⁵	Risk Ratio ⁵	FDEP SCG ⁴	Maximum Exceeds SCG?
INORGANICS (mg/kg)								
Aluminum	17 / 17	2090	2119	NO	78,000	NE	NA	NA
Arsenic	11 / 17	2.6	1.1	YES	23	0.11	NA	NA
Barium	14 / 17	19.9	3.6	YES	5,500	0.0036	NA	NA
Cadmium	1 / 17	0.72	ND	YES	39	0.018	NA	NA
Calcium	17 / 17	46700	115	YES	1,000,000	0.047	NA	NA
Chromium	17 / 17	33	3.7	YES	390	0.085	NA	NA
Cobalt	2 / 17	1	1.6	NO	4,700	NE	NA	NA
Copper	8 / 17	48.4	ND	YES	3,100	0.016	NA	NA
Iron	17 / 17	7260	264	YES	23,000	0.32	NA	NA
Lead	17 / 17	14.5	3.9	YES	400	0.036	NA	NA
Magnesium	16 / 17	949	32.8	YES	400,468	0.0024	NA	NA
Manganese	15 / 17	23.9	2.1	YES	390	0.061	NA	NA
Mercury	5 / 17	0.06	ND	YES	23	0.0026	NA	NA
Nickel	3 / 17	4	ND	YES	1,600	0.0025	NA	NA
Potassium	2 / 17	1660	185	YES	1,000,000	0.0017	NA	NA
Sodium	5 / 17	163	ND	YES	1,000,000	0.00016	NA	NA
Thallium	1 / 17	0.15	ND	YES	6.3	0.024	NA	NA
Vanadium	13 / 17	8.1	3.4	YES	550	0.015	NA	NA
Zinc	10 / 17	56.7	5.6	YES	23,000	0.0025	NA	NA
TOTAL PETROLEUM HYDROCARBONS (mg/kg)								
Total Petroleum Hydrocarbons	12 / 17	594	ND	YES	380	1.6	NA	NA
SUMMARY NON-CANCER RISK RATIO:						2.3		

NOTES:

¹ Based on analytical data from the following sampling locations: 12B00102 to 12B00402, 13B00101, 13B00401, 13B00901 to 13B01301, 14B00102 to 14B00402 (duplicate at 14B00102).

² Frequency of Detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples.

³ The background screening value is twice the average of detected concentrations for inorganic analytes. For organic analytes, values are the mean of detected concentrations, presented for comparison purposes only.

⁴ Values are from USEPA Region III RBC table, October 20, 1995 (USEPA, 1995). RBCs are for residential soil and are based on a hazard quotient of 1 or an excess lifetime cancer risk of 1 in 1 million.

Value for pyrene used as a conservative surrogate for acenaphthylene, benzo(g,h,i)perylene, and phenanthrene.

Value for alpha- and gamma-chlordane based on value for chlordane.

Arsenic is evaluated as a carcinogen and as a non-carcinogen.

Value for chromium based on hexavalent chromium.

RBC is not available for lead; value is from Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites (OSWER Directive 9355.4-12).

TABLE A-5
Human Health Preliminary Risk Evaluation of Subsurface Soil ¹

Area "C"
 Naval Training Center
 Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	USEPA Region III RBC ⁵	Risk Ratio ⁶	FDEP SCG ⁸	Maximum Exceeds SCG?
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Value for mercury based on inorganic mercury.

Value for nickel based on nickel soluble salts.

RBC is not available for TPH. Values are screening values for gasoline and diesel oil derived by ABB-ES; derivation will be documented in methodology text of SSI Rep.

Value for thallium is based on thallium chloride.

⁵ The risk ratio is equal to the maximum detected analyte concentration divided by the USEPA Region III RBC. Risk ratios are calculated for analytes with a maximum detected concentration greater than the background concentration.

A summary cancer risk ratio of 1 roughly corresponds to excess lifetime cancer risk of 1×10^{-6} ; a summary non-cancer risk ratio of 1 roughly corresponds to a hazard index of 1. These ratios tend to overestimate risks, since they are based on maximum detected concentrations.

⁸ Florida Department of Environmental Protection Soil Cleanup Goals for Florida (FDEP, September 29, 1995). Values presented are for leaching scenario.

Value for chromium based on chromium VI.

⁷ Value is the leaching-based value. This analyte was detected in groundwater at a maximum concentration above the FDEP Guidance Concentration.

NA = Not available/Not applicable

ND = Not Detected

NE = Not Evaluated

TABLE A-6
Ecological Preliminary Risk Evaluation of Surface Water ¹

Area "C"
Naval Training Center
Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	Surface Water Screening Value ⁴	Maximum Exceeds Screening Value ?
VOLATILES (µg/L)						
1,1 - Dichloroethene	1 / 5	1.9	ND	YES	3.2	NO
1,2 - Dichloroethene (cis)	3 / 5	1100	ND	YES	1350	NO
1,2 - Dichloroethene (trans)	2 / 5	12	ND	YES	1350	NO
Tetrachloroethylene	2 / 5	9.4	ND	YES	84	NO
Trichloroethene	3 / 5	370	ND	YES	80.7	YES
Vinyl chloride	2 / 5	15	ND	YES	NA	NA

NOTES:

¹ Based on analytical data from the following sampling locations: 13W/D00101 to 13W/D00501.

² Frequency of Detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples.

³ The background screening value is twice the average of detected concentrations for inorganic analytes. For organic analytes, values are the mean detected concentrations, presented for comparison purposes only.

⁴ The surface water screening value is the lesser of the USEPA chronic AWQC, USEPA Region IV chronic water quality standard, or FDEP Class III Fresh Water Standard.

NA = Not Available/Not Applicable

ND = Not Detected

TABLE A-7
Ecological Preliminary Risk Evaluation of Sediment ¹

Area "C"
Naval Training Center
Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	Sediment Screening Value ⁴	Maximum Exceeds Screening Value ?
VOLATILES (mg/Kg)						
1,1-Dichloroethene	2 / 5	0.021	ND	YES	NA	NA
1,2-Dichloroethene (cis)	4 / 5	23	ND	YES	NA	NA
1,2-Dichloroethene (trans)	2 / 5	0.26	ND	YES	NA	NA
Tetrachloroethylene	3 / 5	0.19	ND	YES	NA	NA
Trichloroethene	4 / 5	4.2	ND	YES	NA	NA
Vinyl chloride	2 / 5	0.069	ND	YES	NA	NA

NOTES:

¹ Based on analytical data from the following sampling locations: 13W/D00101 to 13W/D00501.

² Frequency of Detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples.

³ The background screening value is twice the average of detected concentrations for inorganic analytes. For organic analytes, values are the mean detected concentrations, presented for comparison purposes only.

⁴ Sediment screening values for chlorinated VOCs are not available; see discussion in text.

NA = Not Available/Not Applicable

ND = Not Detected

TABLE A-8
Ecological Preliminary Risk Evaluation of Surface Soil ¹

Area "C"
Naval Training Center
Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	Terrestrial PCL ⁴	Maximum Exceeds PCL ?	Phytotoxicity Screening Value ⁵	Maximum Exceeds Screening Value?	Invertebrate Screening Value ⁶	Maximum Exceeds Screening Value?
VOLATILE ORGANIC COMPOUNDS (mg/kg)										
Acetone	2 / 10	0.042	ND	YES	19500	NO	200	NO	NA	NA
Tetrachloroethylene	3 / 10	0.011	ND	YES	3910	NO	1000	NO	150	NO
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)										
Benzo (a) anthracene	1 / 10	0.11	ND	YES	214	NO	25	NO	34	NO
Benzo (b) fluoranthene	1 / 10	0.22	ND	YES	214	NO	25	NO	34	NO
Benzo (g,h,i) perylene	1 / 10	0.18	ND	YES	214	NO	25	NO	34	NO
Benzo (k) fluoranthene	1 / 10	0.18	ND	YES	214	NO	25	NO	34	NO
Chrysene	1 / 10	0.2	ND	YES	214	NO	25	NO	34	NO
Indeno (1,2,3- α) pyrene	1 / 10	0.14	ND	YES	214	NO	25	NO	34	NO
Pyrene	1 / 10	0.23	ND	YES	214	NO	25	NO	34	NO
PESTICIDES/PCBs (mg/kg)										
4,4'-DDE	2 / 10	0.0058	ND	YES	0.284	NO	12.5	NO	12	NO
4,4'-DDT	3 / 10	0.017	ND	YES	0.722	NO	12.5	NO	12	NO
Chlordane-alpha	1 / 10	0.0018	ND	YES	1.8	NO	12.5	NO	1	NO
Chlordane-gamma	1 / 10	0.0016	ND	YES	1.8	NO	12.5	NO	1	NO
INORGANICS (mg/kg)										
Aluminum	10 / 10	2180	2088	YES	7540	NO	2088	YES	NA	NA
Arsenic	4 / 10	0.84	1	NO	107	NE	10	NE	100	NE
Barium	10 / 10	5.8	8.7	NO	6390	NE	500	NE	NA	NA
Beryllium	2 / 10	0.13	0.09	YES	216	NO	10	NO	NA	NA
Cadmium	1 / 10	1.7	0.98	YES	1.82	NO	3	NO	50	NO
Calcium	10 / 10	12400	25295	NO	NA	NA	NA	NA	NA	NA
Chromium	9 / 10	16.4	4.6	YES	15300	NO	4.6	YES	50	NO
Copper	3 / 10	30.2	4.1	YES	662	NO	100	NO	30	YES
Iron	8 / 10	660	712	NO	NA	NA	NA	NA	NA	NA
Lead	8 / 10	40.9	14.5	YES	221	NO	50	NO	1,190	NO
Magnesium	10 / 10	175	328	NO	NA	NA	NA	NA	NA	NA
Manganese	9 / 10	14.7	8.1	YES	6650	NO	500	NO	NA	NA
Mercury	1 / 10	0.07	0.07	NO	10.4	NE	0.3	NE	36	NE
Nickel	3 / 10	9.2	4.4	YES	414	NO	30	NO	400	NO
Vanadium	6 / 10	2.5	3.1	NO	195	NE	3.1	NE	NA	NA
Zinc	6 / 10	52.9	17.2	YES	251	NO	50	YES	130	NO
TOTAL PETROLEUM HYDROCARBONS (mg/kg)										
Total Petroleum Hydrocarbons	8 / 10	40.2	ND	YES	NA	NA	NA	NA	NA	NA

TABLE A-8
Ecological Preliminary Risk Evaluation of Surface Soil ¹

Area "C"
Naval Training Center
Orlando, Florida

ANALYTE	Frequency of Detection ²	Maximum Detected Concentration	Background Concentration ³	Maximum Exceeds Background?	Terrestrial PCL ⁴	Maximum Exceeds PCL ?	Phytotoxicity Screening Value ⁵	Maximum Exceeds Screening Value?	Invertebrate Screening Value ⁶	Maximum Exceeds Screening Value?
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NOTES:

¹ Based on analytical data for the following sample identifiers: 12B00101 to 12B00401 (duplicate at 12B00401), 14B00101 to 14B00401, and 13B00501.

² Frequency of Detection is equal to the number of samples in which the analyte is detected in relation to the total number of samples.

³ The background screening value is twice the average of detected concentrations for inorganic analytes. For organic analytes, values are the mean of detected concentrations, presented for comparison purposes only.

⁴ Screening values are Protective Contaminant Levels (PCLs). The value presented represents the lowest PCL for the short-tailed shrew, american robin, and red-fox.

⁵ Phytotoxicity Screening Value from Suter (1994) and Hulzebos et al. (1993)

⁶ Invertebrate Screening Value from Neuhauser (1985), and others.

⁷ Literature-based value is less than background value, therefore, background value is used as benchmark value.

NA = Not Available/Not Applicable

ND = Not Detected

NE = Not Evaluated. The maximum detected concentration is below the background concentration.

APPENDIX B

SURFACE WATER SCREENING VALUE CALCULATIONS

TABLE B-1
 INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - LAKE DRUID
 CHILD RESIDENT - SWIMMING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical specific	ug/liter	
INGESTION RATE	IR	0.13	liters/day	USEPA, 1989a
AGE-SPECIFIC SURFACE AREA	SA _i	age-specific	cm ²	USEPA, 1989a
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	15	kg	USEPA, 1989a
AGE-SPECIFIC BODY WEIGHT	BW _i	age-specific	kg	USEPA, 1989a
DOSE ABSORBED PER EVENT	DA _{event}	chemical specific	mg/cm ² -event	Calculated
EXPOSURE TIME	ET	2.6	hours/day	USEPA, 1989b
EXPOSURE FREQUENCY	EF	45	days/year	USEPA, 1991a
EXPOSURE DURATION	ED	11	years	Assumption
AGE-SPECIFIC EXPOSURE DURATION	ED _i	age-specific	years	USEPA, 1989a
AGE-WEIGHTED SURFACE AREA [1]	SA _{aw/dj}	3066	cm ² -yr/kg	Calculated per USEPA, 1992
DIFFUSION DEPTH PER EVENT	PC _{event}	chemical specific	cm/event	Calculated per USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991b
NONCANCER	AT	11	years	Assumption
CONVERSION FACTOR	CF1	0.001	mg/ug	
CONVERSION FACTOR	CF2	0.001	liter/cm ³	

[1] Age weighted, body weight normalized surface area

PC_{event} calculated per Dermal Exposure Assessment Appendix of this document.

Ingestion Rate = 0.13 l/day = 50 ml/hour x 2.6 hours/day x 0.001 l/ml

Surface Area assumes lower legs, hands, feet are exposed.

USEPA, 1989a. Exposure Factors Handbook; EPA/600/8-89/043; May 1989.

USEPA, 1989b. Risk Assessment Guidance for Superfund, Volume I, Part A, EPA/540/1-89/002, December 1989.

USEPA, 1991a. Supplemental USEPA Region IV Guidance, March 21, 1991.

USEPA, 1991b. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters".

USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B. See Table B-3.

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE-INGESTION} = \frac{\text{CW} \times \text{IR} \times \text{EF} \times \text{ED} \times \text{CF1}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{\text{DA}_{\text{event}} \times \text{EV} \times \text{EF} \times \text{SA}_{\text{aw/dj}}}{\text{AT} \times 365 \text{ days/yr}}$$

Where:

$$\text{SA}_{\text{aw/dj}} = \text{Sum (SA}_i \times \text{ED}_i / \text{BW}_i)$$

$$\text{DA}_{\text{event}} = \text{PC}_{\text{event}} \times \text{CW} \times \text{CF1} \times \text{CF2}$$

Note:

For non-carcinogenic effects AT = ED

TABLE B-1, continued

ORLCRSWS 16-Jan-96

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - LAKE DRUID
 CHILD RESIDENT - SWIMMING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION (1)	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	PC EVENT (2) (cm ² /year)	INTAKE DERMAL (mg/kg-day)	DERMAL CSF (3) (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
1,1-Dichloroethene	1.9	ug/liter	3.2E-07	6.0E-01	1.9E-07	5.22E-02	5.4E-07	6.0E-01	3.2E-07	5.1E-07
Tetrachloroethene	9.4	ug/liter	1.6E-06	5.2E-02	8.2E-08	2.03E-01	1.0E-05	5.2E-02	5.4E-07	6.2E-07
Trichloroethene	370	ug/liter	6.2E-05	1.1E-02	6.8E-07	5.90E-02	1.2E-04	1.1E-02	1.3E-06	2.0E-06
Vinyl chloride	15	ug/liter	2.5E-06	1.9E+00	4.8E-06	2.20E-02	1.8E-06	1.9E+00	3.4E-06	8.2E-06
SUMMARY CANCER RISK					6E-06				6E-06	1E-05

(1) Exposure point concentrations for carcinogenic PAH compounds have been adjusted by application of USEPA Region IV Toxicity Equivalence Factors (February 10, 1992).

(2) This chemical-specific value has been calculated in a separate spreadsheet.

(3) Calculated from Oral CSFs.

ND = No data available

TABLE B-1, continued
 INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - LAKE DRUID
 CHILD RESIDENT - SWIMMING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION (mg/l)	UNITS	INTAKE INGESTION (mg/ka-day)	ORAL RfD (mg/ka-day)	HAZARD QUOTIENT INGESTION	PC EVENT [1] (cm/event)	INTAKE DERMAL (mg/ka-day)	DERMAL RfD [2] (mg/ka-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
1,1-Dichloroethene	1.9	ug/liter	2.0E-06	9.0E-03	2.3E-04	5.22E-02	3.4E-06	9.0E-03	3.8E-04	6.0E-04
Tetrachloroethene	9.4	ug/liter	1.0E-05	1.0E-02	1.0E-03	2.03E-01	6.6E-05	1.0E-02	6.6E-03	7.6E-03
Trichloroethene	370	ug/liter	4.0E-04	6.0E-03	6.6E-02	5.90E-02	7.5E-04	6.0E-03	1.3E-01	1.9E-01
Vinyl chloride	15	ug/liter	1.6E-05	ND	ND	2.20E-02	1.1E-05	ND	ND	ND
cis-1,2-Dichloroethene	1100	ug/liter	1.2E-03	9.0E-03	1.3E-01	3.93E-02	1.5E-03	9.0E-03	1.7E-01	3.0E-01
trans-1,2-Dichloroethene	12	ug/liter	1.3E-05	9.0E-03	1.4E-03	3.93E-02	1.6E-05	9.0E-03	1.8E-03	3.2E-03
SUMMARY HAZARD INDEX					2E-01				3E-01	5E-01

[1] This chemical-specific value has been calculated in a separate spreadsheet.

[2] Calculated from Oral RfDs.

ND = No data available

TABLE B-2

INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - LAKE DRUID
ADULT RESIDENT - SWIMMING
NAVAL TRAINING CENTER
ORLANDO, FLORIDA
EXPOSURE PARAMETERS

ORLARSWS 16-Jan-96

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE
CONCENTRATION WATER	CW	chemical specific	ug/liter	
INGESTION RATE	IR	0.13	liters/day	USEPA, 1989a
SURFACE AREA	SA	23,000	cm ²	USEPA, 1989a
EVENT FREQUENCY	EV	1	events/day	Assumption
BODY WEIGHT	BW	70	kg	USEPA, 1991a
DOSE ABSORBED PER EVENT	DA _{event}	chemical specific	mg/cm ² -event	Calculated
EXPOSURE TIME	ET	2.6	hours/day	USEPA, 1989b
EXPOSURE FREQUENCY	EF	45	days/year	USEPA, 1991b
EXPOSURE DURATION	ED	24	years	Assumption
DIFFUSION DEPTH PER EVENT	PC _{event}	chemical specific	cm/event	Calculated per USEPA, 1992
AVERAGING TIME				
CANCER	AT	70	years	USEPA, 1991a
NONCANCER	AT	24	years	Assumption
CONVERSION FACTOR	CF1	0.001	mg/ug	
CONVERSION FACTOR	CF2	0.001	liter/cm ³	

PC_{event} calculated per Dermal Exposure Assessment Appendix of this document.

Ingestion Rate = 0.13 l/day = 50 ml/hour x 2.6 hours/day x 0.001 l/ml

Surface Area assumes total body exposed.

USEPA, 1989a. Exposure Factors Handbook; EPA/600/8-89/043; May 1989.

USEPA, 1989b. Risk Assessment Guidance for Superfund, Volume I, Part A, EPA/540/1-89/002, December 1989.

USEPA, 1991a. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Parameters";

USEPA, 1991b. Supplemental Region IV Risk Assessment Guidance, March 26, 1991.

USEPA, 1992. Dermal Exposure Assessment: Principles and Applications; EPA/600/8-91/011B. See Table B-3.

$$\text{CANCER RISK} = \text{INTAKE (mg/kg-day)} \times \text{CANCER SLOPE FACTOR (mg/kg-day)}^{-1}$$

$$\text{HAZARD QUOTIENT} = \text{INTAKE (mg/kg-day)} / \text{REFERENCE DOSE (mg/kg-day)}$$

$$\text{INTAKE-INGESTION} = \frac{\text{CW} \times \text{IR} \times \text{EF} \times \text{ED} \times \text{CF1}}{\text{BW} \times \text{AT} \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{\text{DA}_{\text{event}} \times \text{EV} \times \text{EF} \times \text{ED} \times \text{SA}}{\text{AT} \times \text{BW} \times 365 \text{ days/yr}}$$

Where:

$$\text{DA}_{\text{event}} = \text{PC}_{\text{event}} \times \text{CW} \times \text{CF1} \times \text{CF2}$$

Note:

For non-carcinogenic effects: AT = ED

TABLE B-2, continued
 INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - LAKE DRUID
 ADULT RESIDENT - SWIMMING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 CARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION (1)	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL CSF (mg/kg-day) ⁻¹	CANCER RISK INGESTION	PC EVENT ⁽²⁾ (cm ² /wt)	INTAKE DERMAL (mg/kg-day)	DERMAL CSF (3) (mg/kg-day) ⁻¹	CANCER RISK DERMAL	TOTAL CANCER RISK
1,1-Dichloroethene	1.9	ug/liter	1.5E-07	6.0E-01	8.9E-08	5.22E-02	1.4E-06	6.0E-01	8.3E-07	9.2E-07
Tetrachloroethene	9.4	ug/liter	7.4E-07	5.2E-02	3.8E-08	2.03E-01	2.7E-05	5.2E-02	1.4E-06	1.4E-06
Trichloroethene	370	ug/liter	2.9E-05	1.1E-02	3.2E-07	5.90E-02	3.0E-04	1.1E-02	3.3E-06	3.7E-06
Vinyl chloride	15	ug/liter	1.2E-06	1.9E+00	2.2E-06	2.20E-02	4.6E-06	1.9E+00	8.7E-06	1.1E-05
SUMMARY CANCER RISK					3E-06				1E-05	2E-05

[1] Exposure point concentrations for any carcinogenic PAHs have been adjusted by application of USEPA Region IV Toxicity Equivalence Factors (February 10, 1992)

[2] This chemical-specific value has been calculated in a separate spreadsheet

[3] Calculated from Oral CSFs.

ND = No data available

TABLE B-2, continued
 INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - LAKE DRUID
 ADULT RESIDENT - SWIMMING
 NAVAL TRAINING CENTER
 ORLANDO, FLORIDA
 NONCARCINOGENIC EFFECTS

COMPOUND	WATER CONCENTRATION (mg/l)	UNITS	INTAKE INGESTION (mg/kg-day)	ORAL RfD (mg/kg-day)	HAZARD QUOTIENT INGESTION	PCVENT[1] (cm/hr-yr)	INTAKE DERMAL (mg/kg-day)	DERMAL RfD [2] (mg/kg-day)	HAZARD QUOTIENT DERMAL	TOTAL HAZARD QUOTIENT
1,1-Dichloroethene	1.9	ug/liter	4.4E-07	9.0E-03	4.8E-05	5.22E-02	4.0E-06	9.0E-03	4.5E-04	4.9E-04
Tetrachloroethene	9.4	ug/liter	2.2E-06	1.0E-02	2.2E-04	2.03E-01	7.7E-05	1.0E-02	7.7E-03	7.9E-03
Trichloroethene	370	ug/liter	8.5E-05	6.0E-03	1.4E-02	5.90E-02	8.8E-04	6.0E-03	1.5E-01	1.6E-01
Vinyl chloride	15	ug/liter	3.4E-06	NI		2.20E-02	1.3E-05	ND		
cis-1,2-Dichloroethene	1100	ug/liter	2.5E-04	9.0E-03	2.8E-02	3.93E-02	1.8E-03	9.0E-03	1.9E-01	2.2E-01
trans-1,2-Dichloroethene	12	ug/liter	2.7E-06	9.0E-03	3.1E-04	3.93E-02	1.9E-05	9.0E-03	2.1E-03	2.4E-03
SUMMARY HAZARD INDEX					4E-02				4E-01	4E-01

[1] This chemical-specific value has been calculated in a separate spreadsheet

[2] Calculated from Oral RfDs.

ND = No data available

TABLE B-3
CURRENT USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - LAKE DRUID
ADULT AND/OR CHILD RESIDENT/ TRANSIENT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

RSPCEV 16-Jan-96

EXPOSURE PARAMETERS

EQUATIONS

PARAMETER	SYMBOL	VALUE	UNITS	SOURCE	
Diffusion depth per event	PC_{event}	chemical specific	cm/event		INORGANICS
Permeability Constant	PC	chemical specific	cm/hr	USEPA, 1992	$PC_{event} = PC \times t_{event}$
Duration of a Single Event	t_{event}	2.6	hr	USEPA, 1989	ORGANICS
Thickness of Stratum Corneum	L_{sc}	10	um	USEPA, 1992	$PC_{event} = 2PC \times (6T \times t_{event}/\pi)^{0.5}$
Octanol-water partition coefficient/ 10^4	B	chemical specific	dimensionless	USEPA, 1992	Where $t_{event} < t^*$
Pi	π	3.14	dimensionless	USEPA, 1992	
	T	chemical specific	hr	USEPA, 1992	and: $PC_{event} = PC \times ((t_{event}/(1+B)) + 2T \times ((1+3B)/(1+B)))$
Time to Reach Steady State	t^*	chemical specific	hr	USEPA, 1992	Where $t_{event} > t^*$
Stratum Corneum Diffusion Coefficient	D_{sc}	chemical specific	cm ² /hr	USEPA, 1992	Note: $T = L_{sc}^2/6D_{sc}$
REFERENCES					
USEPA, 1989. Risk Assessment Guidance for Superfund, Volume I, Part A, EPA/540/1-89/002, December 1989. This value is receptor-specific					
USEPA, 1992. Dermal Exposure Assessment: Principles and Applications.					
The term T is not calculated here. Values are provided in USEPA, 1992.					

TABLE B-3, continued

RSPCEV

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CURRENT USE INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - LAKE DRUID
ADULT AND/OR CHILD RESIDENT/ TRANSIENT
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

COMPOUND	INORGANIC OR ORGANIC? I/O	PC (cm/hr)	T (hr)	t* (hr)	B (unitless)	PC _{event} (cm/event)
1,1-Dichloroethene	O	1.6E-02	3.4E-01	8.2E-01	1.3E-02	5.22E-02
Tetrachloroethene	O	4.8E-02	9.0E-01	4.3E+00	2.5E-01	2.03E-01
Trichloroethene	O	1.6E-02	5.5E-01	1.3E+00	2.6E-02	5.90E-02
Vinyl chloride	O	7.3E-03	2.1E-01	5.1E-01	2.3E-03	2.20E-02
cis-1,2-dichloroethene	O	1.2E-02	3.4E-01	8.2E-01	7.2E-03	3.93E-02
trans-1,2-dichloroethene	O	1.2E-02	3.4E-01	8.2E-01	7.2E-03	3.93E-02
NA = Not applicable. For inorganic analytes, this term is not used to calculate PCevent.						
REFERENCES:						
Unless otherwise noted, values are taken from USEPA, 1992. Dermal Exposure Assessment: Principles and Applications, EPA/600/8-91/011B						

TABLE B-4
CALCULATION OF SURFACE WATER SCREENING VALUES (SWSVs)

LAKE DRUID
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Analyte	EPC (ug/L)	Child Resident ELCR [a]	Adult Resident ELCR [b]	Total Resident ELCR [c]	SWSV Cancer [d]	Child Resident HQ [e]	SWSV Non-cancer [d]	Selected SWSV [f] (ug/L)
1,1-Dichloroethene	1.9	5.1E-07	9.2E-07	1.4E-06	1.3	6.0E-04	3167	1.3
Tetrachloroethene	9.4	6.2E-07	1.4E-06	2.0E-06	4.7	7.6E-03	1237	4.7
Trichloroethene	370	2.0E-06	3.7E-06	5.7E-06	64.9	1.9E-01	1947	64.9
Vinyl chloride	15	8.2E-06	1.1E-05	1.9E-05	0.8	NA	NA	0.8
cis-1,2-Dichloroethene	1100	NA	NA	NA	NA	3.0E-01	3667	3667
trans-1,2-Dichloroethene	12	NA	NA	NA	NA	3.2E-03	3750	3750

Notes:

[a] Calculated in Table B-1.

[b] Calculated in Table B-2.

[c] Sum of child and adult ELCRs.

[d] Calculated by solving for the surface water concentration at $ELCR = 1 \times 10^{-6}$ or $HI = 1$, based on the total resident ELCR or child resident HI, as described in text.

[e] Calculated in Table B-1. The greater of the child or adult resident HIs is selected as the basis of the SWSV.

[f] Value is the lesser of the SWSV cancer or SWSV non-cancer.

APPENDIX C

INDOOR AIR CALCULATIONS AND PRELIMINARY RISK EVALUATION

Indoor air concentrations of VOCs were also estimated using the farmer model as presented by USEPA (USEPA 1992) in conjunction with the USEPA recommended approach shown below for calculating indoor air concentrations. The farmer model calculates the flux of VOC across the soil-building slab boundary. The flux rate, expressed as micrograms per second per square centimeter at the building floor, is a function of soil porosity, pore space geometry, air diffusion coefficients, and the difference in concentration in the soil gas and the building air.

The indoor air concentration is calculated per USEPA guidance (USEPA 1992) as:

$$C_{indoor} = E/Q \quad (2)$$

where:

E = Contaminant infiltration rate
Q = Building ventilation rate

The building ventilation rate is calculated by:

$$Q = (ACH/3600) \times V \quad (3)$$

where:

ACH = Air changes per hour in building
V = Volume of building (m³)
3600 = Units conversion factor (sec/hr)

The contaminant infiltration rate of VOCs due to diffusion into the building is calculated by

$$E = J \times A \times F \times CF_1 \quad (4)$$

where:

J = Contaminant flux (μg/cm²-sec)
A = Area of building floor in contact with soil gas (m²) as described below.
F = Fraction of floor through which soil gas can enter (assumed here to be 100%)
CF₁ = Units conversion factor (10⁴ cm²/m²)

The contaminant flux is calculated per USEPA guidance (USEPA 1992):

and

$$J = D_s (C_g - C_2) CF_2 / L \quad (5)$$

$$D_s = D_A P_a^{10/3} / P_T^2 \quad (6)$$

where:

D_s	=	Effective diffusion coefficient (cm ² /sec)
D_A	=	Vapor phase diffusion coefficient in air (cm ² /sec)
P_a	=	Air filled porosity (unitless)
L	=	Distance from source to point of exit (cm)
P_T	=	Total soil porosity (unitless)
C_2	=	Background concentration in indoor air (μg/m ³) [assumed here to be zero]
CF_2	=	Units conversion factor (10 ⁻⁶ m ³ /cm ³)

The estimated equilibrium soil gas concentration adjacent to the buildings is used here to represent the vapor phase concentration (C_g) at a theoretical source near the building. The equilibrium soil gas concentration is estimated by assuming that VOCs in well OLD-13-01A are in equilibrium with soil gas at the water table. The soil gas concentration is estimated by the use of the dimensionless Henry's Law Constant.

The estimated soil gas concentration, C_g is:

$$C_g = C_{gw} \times H \times CF_3 \quad (7)$$

where:

C_{gw}	=	Concentration of VOC in groundwater (μg/liter)
H	=	Dimensionless Henry's Law Constant
CF_3	=	Units conversion factor (1000 liters/m ³)

There are several conservative assumptions included in this model. The assumption that $C_2 = 0$ tends to somewhat overestimate the vapor migration into the buildings (USEPA 1992). The area of the building used here is intended to represent a 14 foot by 14 foot bedroom with 8 foot high ceilings. It is assumed that groundwater containing VOCs is beneath the entire area of that theoretical room. It is also assumed that the fraction of the floor through which gas can enter is 100 percent. If the floor overlying the soil is a concrete pad, then potential gas infiltration would be substantially lower.

The results of the farmer model evaluation, including estimated indoor air concentrations, are presented in Table C-1. The estimated indoor air concentrations have been compared to USEPA Region III Risk-Based Concentrations for ambient air in order to provide a preliminary evaluation of the risks potentially

associated with exposure to these estimated concentrations. This comparison is presented in the following Table. Results are discussed in the PRE.

*Analyte	Estimated Indoor Air Concentration ($\mu\text{g}/\text{M}^3$)	USEPA Region III RBC For Ambient Air ($\mu\text{g}/\text{M}^3$)	Risk Ratio
Tetrachloroethylene	180	3.1	58
Trichloroethylene	8.29	1	8.3
Summary Cancer Risk Ratio:			66
cis-1,2-dichloroethene	14.4	37	0.39
Summary Noncancer Risk Ratio:			0.4

TABLE C-1
Farmer's Model approach to deriving indoor air concentrations associated with groundwater contamination

AREA "C"
NAVAL TRAINING CENTER
ORLANDO, FLORIDA

Compound	GW Concentration ug/liter (1)	Henry's Law Constant dimensionless at 20 deg C (2)	Equilibrium Soil Gas Concentration ug/cu m	Area of Building Floor sq m	Fraction of Floor	Air Changes per Hour	Volume of Building cu m	Diffusion Coefficient DsubA sq cm/sec 20 degrees C (2)	Air Filled Soil Porosity	Total Soil Porosity	Distance from Source to point of exit cm	Flux @max sg ug/sq cm-sec	Indoor Air Concentration @max sg ug/cu m
tetrachloroethylene	250	0.59	147,500	18.2	1	0.5	44.4	0.0759	0.35	0.55 SEAM	183	0.0000081106	180.43
trichloroethylene	16	0.38	6,080	18.2	1	0.5	44.4	0.0846	0.35	0.55 SEAM	183	0.000002908	8.29
cis-1,2-dichloroethene	29	0.32	9,280	18.2	1	0.5	44.4	0.0984	0.35	0.55 SEAM	183	0.000004893	14.42

(1) Data from well OLD-13-01 samples 3/9/95

(2) From Haerhoff, J. and J.L. Cleasby, Evaluation of air stripping for the removal of organic drinking-water contaminants Water SA Vol. 16, No. 1, January 1990.

183 cm = 6 feet from groundwater to building slab

ATTACHMENT B

INITIAL SCREENING RESULTS

AREA C - TEMPORARY WELL AND TERRAPROBE POINTS - GC RESULTS

SAMPLE ID	SAMPLE LOCATION	SAMPLE DEPTH (ft.)	DATE ANALYZED	TCE (ppb)	PCE (ppb)
13G00901	13G009	8	12/22/95		
13G01001	13G010	8	12/22/95		
13G01101	13G011	8	12/22/95		
13G01201	13G012	8	12/22/95		
13G01301	13G013	8	12/22/95		
13G01401	13G014	8	12/22/95		
13G01501	13G015	8	12/22/95		
13G01601	13G016	8	12/22/95		
13G01701	13G017	8	12/22/95	107.70	99.80
13G01801	13G018	8	12/22/95	4.75	6.51
13G01901	13G019	8	12/26/95		
13G01901D	13G019	8	12/26/95		
13G02001	13G020	8	12/26/95		
13G02101	13G021	8	12/26/95		
13Q00101	13Q001	8	12/22/95		1.54
13Q00102	13Q001	18	12/26/95	59.25	
13Q00103	13Q001	30	12/26/95	8.33	109.58
13Q00201	13Q002	8	12/22/95		
13Q00202	13Q002	18	12/26/95	45.83	
13Q00203	13Q002	30	12/26/95	23.38	24.14
13Q00301	13Q003	8	12/22/95		
13Q00302	13Q003	18	12/26/95		11.15
13Q00303	13Q003	30	12/26/95	17.97	11.96
13Q00401	13Q004	8	12/22/95		1.65
13Q00402	13Q004	18	12/26/95		8.81
13Q00403	13Q004	30	12/26/95	277.63	167.89
13Q00501	13Q005	8	12/22/95		0.29
13Q00502	13Q005	18	12/26/95		50.62
13Q00503	13Q005	30	12/26/95	1059.73	21.92
13Q00601	13Q006	8	12/22/95		3.01
13Q00602	13Q006	18	12/26/95	28.99	17.02
13Q00603	13Q006	30	12/26/95	852.54	821.13
13Q00701	13Q007	8	12/22/95	129.90	250.83
13Q00702	13Q007	18	12/27/95	391.13	4325.75
13Q00703	13Q007	30	12/27/95	41.05	272.04
13Q00801	13Q008	8	12/22/95	5.08	136.30
13Q00802	13Q008	18	12/27/95	54.16	468.83
13Q00803	13Q008	30	12/27/95	7.58	23.38
13Q00901	13Q009	8	12/22/95	1.85	16.06
13Q00902	13Q009	18	12/22/95		0.80
13Q00903	13Q009	30	12/22/95		3.01

AREA C - TEMPORARY WELL AND TERRAPROBE POINTS - GC RESULTS

SAMPLE ID	SAMPLE LOCATION	SAMPLE DEPTH (ft.)	DATE ANALYZED	TCE (ppb)	PCE (ppb)
13Q01001	13Q010	8	12/22/95		0.27
13Q01002	13Q010	18	12/27/95	51.04	1346.35
13Q01003	13Q010	30	12/27/95	604.45	1333.36
13Q01101	13Q011	8	12/22/95		
13Q01102	13Q011	18	12/27/95	8.61	863.46
13Q01103	13Q011	30	12/27/95	98.66	951.95
13Q01201	13Q012	8	12/22/95		4.27
13Q01202	13Q012	18	12/27/95		3.10
13Q01203	13Q012	30	12/27/95		43.24
13Q01301	13Q013	8	12/26/95		36.96
13Q01302	13Q013	18	12/27/95	0.05	0.13
13Q01303	13Q013	30	12/28/95		1.53
13Q01401	13Q014	8	12/26/95	10.25	1321.69
13Q01402	13Q014	18	12/27/95	379.28	1244.52
13Q01403	13Q014	30	12/27/95	7.20	73.55
13Q01501	13Q015	8	12/26/95		0.80
13Q01502	13Q015	18	12/28/95		4.93
13Q01503	13Q015	30	12/27/95	5.62	71.06
13Q01601	13Q016	8	12/28/95	0.34	1.11
13Q01602	13Q016	18	12/28/95		
13Q01603	13Q016	30	12/28/95		
13Q01701	13Q017	8	12/28/95		
13Q01702	13Q017	18	12/28/95		
13Q01703	13Q017	30	12/28/95		
13Q01801	13Q018	8	12/28/95		1.35
13Q01802	13Q018	18	12/28/95		
13Q01803	13Q018	30	12/28/95		
13Q01901	13Q019	8	12/28/95		
13Q01902	13Q019	18	12/28/95		
13Q01903	13Q019	30	12/28/95		
13Q02001	13Q020	8	12/28/95		
13Q02002	13Q020	18	12/28/95		
13Q02101	13Q021	8	12/28/95		
13Q02102	13Q021	18	12/28/95		

AREA C - TEMPORARY WELLS, SURFACE WATER AND SEDIMENT - LABORATORY RESULTS

SAMPLE ID	1,1 - DICHLOROETHENE (ppb)	CIS - 1,2 - DICHLOROETHENE (ppb)	TRANS - 1,2 - DICHLOROETHENE (ppb)	(TOTAL) - 1,2 - DICHLOROETHENE (ppb)	TETRACHLOROETHENE (PCE) (ppb)	TRICHLOROETHENE (TCE) (ppb)	VINYL CHLORIDE (ppb)
13W00101		7.7		7.7			
13W00201		1100	12	1112	5.9	340	2.2
3W00201		1100	11	1111	4.7	370	1.8
13W00301	1.5	180	2.5	182.5	6.6	33	15
13W00401						3	
13W00501							
13W00601		4.7		4.7			
13W00701		4.3		4.3			
13W00801		5.8		5.8		1.2	
13W00901		4.9		4.9			
13W01001		5.3		5.3			
13W01101		4.6		4.6			
13D00101		5.7		5.7		2.3	
13D00201		890	18	908		38	
13D00201	21	3200	24	3224	28		69
13D00301	10	23000	260	23260	190	4200	13
13D00401		19		19	7.3	19	
13D00501							
13D00601							
13D00701							
13D00801					18	11	
13D00901		37		37	10	44	
13D01001							
13D01101							
13G00901							
13G01001							
13G01101							
13G01201							
13G01301							
13G01401							
13G01501							

AREA C - TEMPORARY WELLS, SURFACE WATER AND SEDIMENT - LABORATORY RESULTS

SAMPLE ID	1,1 - DICHLORETHENE (ppb)	CIS - 1,2 - DICHLOROETHENE (ppb)	TRANS - 1,2 - DICHLOROETHENE (ppb)	(TOTAL) - 1,2 - DICHLOROETHENE (ppb)	TETRACHLOROETHENE (PCE) (ppb)	TRICHLOROETHENE (TCE) (ppb)	VINYL CHLORIDE (ppb)
13G01601							
13G01701				320	120	170	2
13G01801				34	23	14	
13G01901							
13G02001							
13G02101							
13Q00603				51	760	2100	
13Q00701				770	1600	240	16
13Q00702				7	270	18	
13Q01002				25	2500	84	
13Q01003				39	2000	2200	
13Q01103				270	6400	400	

ATTACHMENT C

AREA C SUPPLEMENTAL HEALTH AND SAFETY PLAN ADDENDUM

Preface

The following pages constitute the Health and Safety Plan (HASP) addendum for the Naval Training Center (NTC), Orlando Project Operations Plan (POP) for Site Investigations and Remedial Investigations. This addendum must be used in conjunction with the existing generic HASP for NTC, Orlando. The pages in this addendum should be inserted, where indicated, in the generic HASP. The generic HASP, with these pages correctly inserted, completes the update of the NTC, Orlando HASP for the IRA focused field investigation at OU 4.

2.3 SCOPE OF WORK (WORKPLAN). This focused field investigation at OU 4, concentrating on Lake Druid, will consist of surface water and sediment sampling in Lake Druid, groundwater sample collection via cone penetrometer, advancement of soil borings and collection of subsurface soil samples via hollow-stem auger, and completion of these borings as monitoring wells for groundwater sampling.

Objective: Provide further delineation of the horizontal and vertical extent of the chlorinated solvent contamination in Lake Druid sediment and surface water.

Methods:

- surface water sampling
- sediment sampling
- drive point and seepage meter installation

Objective: Further characterize groundwater contamination adjacent to Lake Druid to determine the mechanism for contamination of the lake. Also to provide data necessary to remediate VOC contamination in the lake.

Methods:

- groundwater sampling using cone penetrometer
- monitoring well installation
- groundwater sampling

2.4.5 Monitoring The work environment will be monitored to ensure that Immediately Dangerous to Life and Health (IDLH) or other dangerous conditions are identified. At a minimum, monitoring will include evaluations for combustible atmospheres, oxygen-deficient environments, and hazardous concentrations of airborne contaminants. The combustible gas meter, set to alarm at 10 percent of the lower explosive limit (LEL), will be continuously used.

2.4.6 Air Sampling To the extent feasible, the presence of airborne contaminants will be evaluated through the use of direct reading instrumentation. Information gathered will be used to ensure the adequacy of the levels of protection being used at the site, and may be used as the basis for upgrading or downgrading the levels of protection in conformance with action levels provided in this HASP and at the direction of the site HSO. Contaminants expected to be a concern at OU 4 are shown on Table 2-2.

The following sampling equipment will be used at the site:

1. PORTA-FID OVA,
2. Drager pump with vinyl chloride 0.5/a tubes, and
3. lower explosion limit (LEL)/oxygen meter.

Refer to Appendix F for information on the calibration and maintenance of the equipment.

Interim Remedial Action
Focused Field Investigation Workplan, OU 4
Naval Training Center
Orlando, Florida

Chemical	Approximate Odor Threshold (ppm)	Permissible Exposure Limits (ppm)	Threshold Limit Value (ppm)	Physical Character- istics	Dermal Toxicity	Remarks
1,1-Dichloroethene (vinylidene chloride)	190	1	10	Colorless liquid, sweet odor.	Smarting of skin and 1st degree burns.	Vapor can cause dizziness and drunkenness; high levels cause anesthesia.
1,2 Dichloroethene	500	200	200	Colorless liquid, sweet odor.	Moderate skin irritant.	Nausea, vomiting, weakness, tremor, cramps, CNS depression.
Tetrachloroethylene	47	25	25	Colorless liquid with an odor like chloroform.	Moderate skin irritant.	Inhalation may irritate eyes and nose and cause CNS damage.
Trichloroethene	82	50	50	Colorless liquid, sweet odor.	Can cause dermatitis.	Eye and nose irritation, blurred vision, nausea, CNS damage.
Vinyl Chloride	20	1	5,A1	Colorless gas, sweet odor.	May cause frostbite.	Dizziness, anesthesia, lung irrita- tion.
Sources:	American Industrial Hygienists Association, 1989. U.S. Department of Transportation and U.S. Coast Guard, 1991. National Institute of Occupational Safety and Health, 1990. American Conference of Governmental and Industrial Hygienists. Occupational Safety and Health Administration, 1989.					
Notes:	ppm = parts per million. A1 = Known Human Carcinogen.					

The vinyl chloride Drager tubes have a limited range of operating temperatures and humidities. Above certain temperature and humidity combinations, the tubes may not be accurate. Some typical limits are:

<u>Temperature (F)</u>	<u>Relative Humidity (Percent)</u>
86	66
80	79
75	93
73	100

Above 86 F, the tubes should not be used, regardless of humidity. Below 73 F, temperature and humidity limits are not likely to be exceeded in Orlando.

If ambient conditions at OU 4 exceed the above limits, any OVA detections above background must be assumed to be vinyl chloride, as the Drager tubes cannot be relied upon to show otherwise. Under these conditions, a Level B PPE upgrade would be required.

If the OVA reads steadily above background in the breathing zone, begin monitoring with vinyl chloride Drager tubes. If vinyl chloride levels reach or exceed 0.5 ppm in the breathing zone, upgrade to Level B.

If vinyl chloride levels are below 0.5 ppm, continue working in modified Level D until the OVA reads 8 ppm above background in the breathing zone, at which time upgrade to Level C. If the OVA reads 116 ppm (or greater) above background, upgrade to Level B.

If the LEL meter reads 10 percent of the LEL or greater, use non-sparking tools. If the LEL meter reads 20 percent of the LEL or greater, stop work and evacuate the site.

The above action limits are summarized below:

Level B PPE required if:

Vinyl chloride Drager tube \geq 0.5 ppm; or
OVA \geq 116 ppm; or
OVA above background and weather conditions are outside the limits of the Drager tubes.

Level C PPE required if:

Vinyl chloride Drager tube $<$ 0.5 ppm,
and OVA \geq 8 ppm but $<$ 116 ppm.

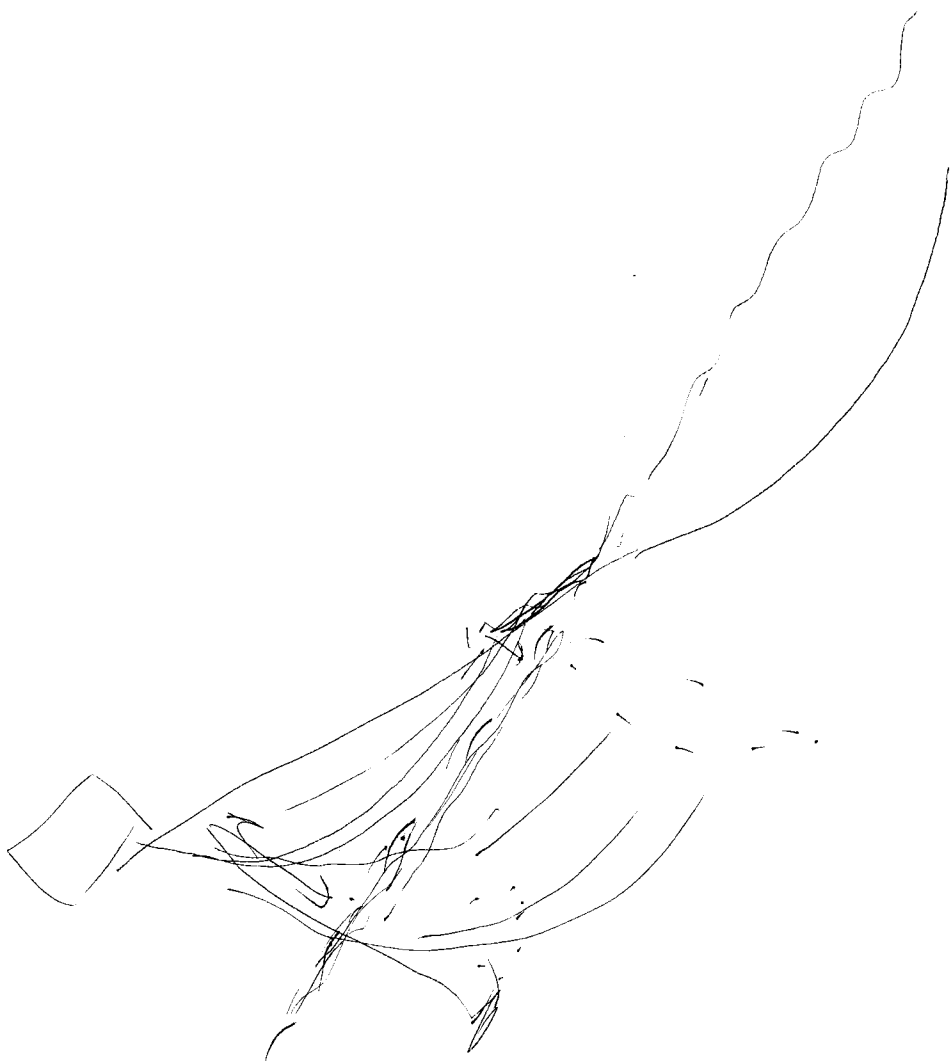
Level D PPE required if:

Vinyl chloride Drager tube < 0.5 ppm; and
OVA < 8 ppm.

Wherever feasible, engineering controls will be used to avoid the need to upgrade from Level D. An example is the use of industrial-sized fans to blow hazardous vapors from the breathing zone.

If air monitoring instrumentation indicates the need to upgrade to Level B along the northern property line, all work will be suspended to avoid the possibility of creating a dangerous condition outside Navy property.

3.0 CHEMICAL HAZARDS RESPONSE INFORMATION SYSTEM (CHRIS) DATA SHEETS



Common Synonyms Acetylene dichloride sym-dichloroethylene Difolom cis-1, 2-dichloroethylene trans-1, 2-dichloroethylene		Liquid	Colorless	Sweet pleasant odor
		Sinks in water. Flammable, irritating vapor is produced.		
Wear goggles and self-contained breathing apparatus. Shut off ignition sources. Call fire department. Stop discharge if possible. Keep people away. Isolate and remove discharged material. Notify local health and pollution control agencies.				
Fire	FLAMMABLE. POISONOUS GASES MAY BE PRODUCED IN FIRE. Containers may explode in fire. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Extinguish with dry chemicals, foam or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.			
Exposure	CALL FOR MEDICAL AID. VAPOR If inhaled will cause dizziness, nausea, vomiting, or difficult breathing. Move victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Harmful if swallowed. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.			
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.			
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Restrict access Evacuate area Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3		
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: $\text{ClCH} = \text{CHCl}$ 3.3 IMO/UN Designation: 3.2/1150 3.4 DOT ID No.: 1150 3.5 CAS Registry No.: 540-59-0		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Ethereal, slightly acid, pleasant, chloroform-like		
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Rubber gloves; safety goggles; air supply mask or self-contained breathing apparatus. 5.2 Symptoms Following Exposure: Inhalation causes nausea, vomiting, weakness, tremor, epigastric cramps, central nervous depression. Contact with liquid causes irritation of eyes and (on prolonged contact) skin. Ingestion causes slight depression to deep narcosis. 5.3 Treatment of Exposure: INHALATION: remove from further exposure; if breathing is difficult, give oxygen; if victim is not breathing, give artificial respiration, preferably mouth-to-mouth; give oxygen when breathing is resumed; call a physician. EYES: flush with water for at least 15 min. SKIN: wash well with soap and water. INGESTION: give gastric lavage and cathartics. 5.4 Threshold Limit Value: 200 ppm 5.5 Short Term Inhalation Limit: Data not available 5.6 Toxicity by Ingestion: Grade 2; oral LD_{50} = 770 mg/kg (rat) 5.7 Late Toxicity: Produces liver and kidney injury in experimental animals 5.8 Vapor (Gas) Irritant Characteristics: Data not available 5.9 Liquid or Solid Irritant Characteristics: Data not available 5.10 Odor Threshold: Data not available 5.11 IDLH Value: 4,000 ppm				

6. FIRE HAZARDS 6.1 Flash Point: 37°F C.C. 6.2 Flammable Limits in Air: 9.7%-12.8% 6.3 Fire Extinguishing Agents: Dry chemical, foam, carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective. 6.5 Special Hazards of Combustion Products: Phosgene and hydrogen chloride fumes may form in fire. 6.6 Behavior in Fire: Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 860°F 6.8 Electrical Hazard: Data not available 6.9 Burning Rate: 2.8 mm/min. 6.10 Adiabatic Flame Temperature: Data not available (Continued)		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X-Y	
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Will not occur under ordinary conditions of shipment. The reaction is not vigorous. 7.6 Inhibitor of Polymerization: None used 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed 11.3 NFPA Hazard Classification: Category Classification Health Hazard (Blue) _____ 2 Flammability (Red) _____ 3 Reactivity (Yellow) _____ 2	
8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 97.0 12.3 Boiling Point at 1 atm: °C: 140°F = 60°C = 333°K °F: 118°F = 48°C = 321°K 12.4 Freezing Point: °C: -114°F = -81°C = 192°K °F: -58°F = -50°C = 223°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.27 at 25°C (liquid) 12.8 Liquid Surface Tension: 24 dynes/cm = 0.024 N/m at 20°C 12.9 Liquid Water Interfacial Tension: (est.) 30 dynes/cm = 0.030 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: 3.34 12.11 Ratio of Specific Heats of Vapor (Gas): 1.1488 12.12 Latent Heat of Vaporization: 130 Btu/lb = 72 cal/g = 3.0 x 10 ⁴ J/kg 12.13 Heat of Combustion: -4,847.2 Btu/lb = -2,692.9 cal/g = -112.67 x 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available	
9. SHIPPING INFORMATION 9.1 Grades of Purity: Commercial 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Pressure-vacuum			
6. FIRE HAZARDS (Continued) 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available			

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
35	81.020	35	.193	65	.907	40	.478
40	80.820	40	.196	70	.894	50	.454
45	80.610	45	.198	75	.882	60	.432
50	80.400	50	.200	80	.869	70	.411
55	80.190	55	.202	85	.857	80	.393
60	79.980	60	.204	90	.844	90	.376
65	79.780	65	.207	95	.832	100	.360
70	79.570	70	.209	100	.819	110	.345
75	79.360	75	.211	105	.807	120	.331
80	79.150	80	.213	110	.794	130	.319
85	78.940	85	.216	115	.782	140	.307
90	78.740	90	.218	120	.769	150	.296
95	78.530	95	.220	125	.757	160	.286
100	78.320	100	.222	130	.744	170	.276
105	78.110	105	.224			180	.267
110	77.900	110	.227			190	.259
115	77.690	115	.229			200	.251
120	77.490	120	.231			210	.244
125	77.280	125	.233				
130	77.070	130	.236				
135	76.860	135	.238				
140	76.650	140	.240				

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68	.630	55	3.009	55	.05284	0	.150
		60	3.396	60	.05906	20	.153
		65	3.824	65	.06587	40	.156
		70	4.297	70	.07330	60	.159
		75	4.817	75	.08141	80	.162
		80	5.389	80	.09023	100	.165
		85	6.016	85	.09980	120	.167
		90	6.702	90	.11020	140	.170
		95	7.453	95	.12140	160	.173
		100	8.272	100	.13360	180	.176
		105	9.164	105	.14660	200	.179
		110	10.130	110	.16070	220	.182
		115	11.190	115	.17590	240	.185
		120	12.330	120	.19220	260	.188
		125	13.560	125	.20960	280	.191
		130	14.900	130	.22830	300	.194
		135	16.340	135	.24820	320	.197
		140	17.890	140	.26960	340	.200
						360	.203
						380	.205
						400	.208
						420	.211
						440	.214

Common Synonyms Tetracap Perclene Perchloroethylene Percl	Wetery liquid Sinks in water. Irritating vapor is produced.	Colorless	Sweet odor
Stop discharge if possible. Avoid contact with liquid and vapor. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire	Not flammable. Poisonous gases are produced when heated.		
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.		
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent	
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Not listed 3.2 Formula: C_2Cl_4 3.3 IMO/IUN Designation: 9.0/1897 3.4 DOT ID No.: 1897 3.5 CAS Registry No.: 127-18-4		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Ethereal, like chloroform, mildly sweet	
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: For high vapor concentrations use approved canister or air-supplied mask; chemical goggles or face shield; plastic gloves. 5.2 Symptoms Following Exposure: Vapor can affect central nervous system and cause anesthesia. Liquid may irritate skin after prolonged contact. May irritate eyes but causes no injury. 5.3 Treatment of Exposure: INHALATION: If illness occurs, remove patient to fresh air, keep him warm and quiet, and get medical attention. INGESTION: induce vomiting only on physician's recommendation. EYES AND SKIN: flush with plenty of water and get medical attention if irritation or injury occurs. 5.4 Threshold Limit Value: 50 ppm 5.5 Short Term Inhalation Limit: 100 ppm for 60 min. 5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg 5.7 Lethal Toxicity: None 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight stinging of the eyes or throat if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause stinging and reddening of the skin. 5.10 Odor Threshold: 5 ppm 5.11 IDLH Value: 500 ppm			

6. FIRE HAZARDS 6.1 Flash Point: Not flammable 6.2 Flammable Limits in Air: Not flammable 6.3 Fire Extinguishing Agents: Not pertinent 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Toxic, irritating gases may be generated in fires. 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: Not flammable 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not flammable 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X	
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: Data not available		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: OSHA 11.2 NAS Hazard Rating for Bulk Water Transportation Category Rating Fire _____ 0 Health _____ 1 Vapor Irritant _____ 1 Liquid or Solid Irritant _____ 1 Poison _____ 2 Water Pollution _____ 3 Human Toxicity _____ 1 Aquatic Toxicity _____ 3 Aesthetic Effect _____ 2 Reactivity _____ Other Chemicals _____ 1 Water _____ 0 Self Reaction _____ 1 11.3 NFPA Hazard Classification: Not listed	
8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: None		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 185.83 12.3 Boiling Point at 1 atm: 250°F = 121°C = 394°K 12.4 Freezing Point: -8.3°F = -22.4°C = 250.8°K 12.5 Critical Temperature: 657°F = 347°C = 620°K 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.63 at 20°C (liquid) 12.8 Liquid Surface Tension: 31.3 dynes/cm = 0.0313 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 44.4 dynes/cm = 0.0444 N/m at 25°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): 1.116 12.12 Latent Heat of Vaporization: 90.2 Btu/lb = 50.1 cal/g = 2.10 X 10 ⁵ J/kg 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available	
9. SHIPPING INFORMATION 9.1 Grades of Purity: Dry cleaning and industrial grades: 95+ % 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Pressure-vacuum		NOTES	

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
35	103.400	0	.198		N O T P E R T I N E N T	55	.958
40	103.099	10	.200			60	.929
45	102.900	20	.201			65	.900
50	102.599	30	.202			70	.873
55	102.299	40	.203			75	.848
60	102.000	50	.204			80	.823
65	101.700	60	.205			85	.800
70	101.400	70	.206			90	.777
75	101.099	80	.207			95	.756
80	100.799	90	.208			100	.736
85	100.500	100	.210			105	.716
90	100.200	110	.211			110	.698
95	99.910	120	.212			115	.680
100	99.610	130	.213			120	.663
105	99.320	140	.214			125	.647
110	98.020	150	.215			130	.631
115	98.730	160	.216			135	.616
120	98.429	170	.217			140	.601
125	98.139	180	.218			145	.588
130	97.839	190	.220			150	.574
135	97.549	200	.221			155	.561
140	97.250	210	.222			160	.549
145	96.959					165	.537
150	96.669					170	.526
155	96.370					175	.515
160	96.080						

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	.016	60	.236	60	.00702	0	.108
		70	.318	70	.00929	25	.110
		80	.425	80	.01216	50	.113
		90	.561	90	.01575	75	.116
		100	.732	100	.02022	100	.118
		110	.948	110	.02571	125	.120
		120	1.217	120	.03242	150	.122
		130	1.548	130	.04055	175	.125
		140	1.953	140	.05032	200	.127
		150	2.446	150	.06199	225	.129
		160	3.042	160	.07583	250	.131
		170	3.756	170	.09215	275	.132
		180	4.607	180	.11130	300	.134
		190	5.616	190	.13360	325	.136
		200	6.805	200	.15940	350	.138
		210	8.199	210	.18910	375	.139
		220	9.824	220	.22330	400	.141
		230	11.710	230	.26230	425	.142
		240	13.890	240	.30660	450	.143
		250	16.390	250	.35680	475	.144
		260	19.260	260	.41330	500	.146
		270	22.520	270	.47680	525	.147
		280	26.230	280	.54790	550	.148
						575	.148
						600	.149

TRICHLOROETHYLENE

TCL

Common Synonyms Trichloroethylene Triclene; Aiglyen Chlorylene Gemalene Trenylene Trichloran; Triene	Watery liquid Colorless Sweet odor Sinks in water. Irritating vapor is produced.
<p>Stop discharge if possible. Keep people away. Avoid contact with liquid and vapor. Call fire department. Isolate and remove discharged material. Notify local health and pollution control agencies.</p>	
Fire	<p>Combustible. POISONOUS GASES ARE PRODUCED IN FIRE. Wear goggles and self-contained breathing apparatus. Extinguish with dry chemical, carbon dioxide, or foam.</p>
Exposure	<p>CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose and throat. If inhaled, will cause nausea, vomiting, difficult breathing, or loss of consciousness. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Irritating to skin and eyes. If swallowed, will cause nausea, vomiting, difficult breathing, or loss of consciousness. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk and have victim induce vomiting. IF SWALLOWED and victim is UNCONSCIOUS OR HAVING CONVULSIONS, do nothing except keep victim warm.</p>
Water Pollution	<p>Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and waste officials. Notify operators of nearby water intakes.</p>
<p>1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed. Chemical and physical treatment.</p>	
<p>3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Halogenated hydrocarbon 3.2 Formula: $\text{CHCl}_2 = \text{CCl}_2$ 3.3 IMO/UN Designation: 9.0/1710 3.4 DOT ID No.: 1710 3.5 CAS Registry No.: 79-01-6</p>	
<p>5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Organic vapor-acid gas canister; self-contained breathing apparatus for emergencies; neoprene or vinyl gloves; chemical safety goggles; face-shield; neoprene safety shoes; neoprene suit or apron for splash protection. 5.2 Symptoms Following Exposure: INHALATION: symptoms range from irritation of the nose and throat to nausea, an attitude of irresponsibility, blurred vision, and finally disturbance of central nervous system resulting in cardiac failure. Chronic exposure may cause organic injury. INGESTION: symptoms similar to inhalation. SKIN: irritating action can cause dermatitis. EYES: slightly irritating sensation and lachrymation. 5.3 Treatment of Exposure: Do NOT administer adrenalin or epinephrine; get medical attention for all cases of overexposure. INHALATION: remove victim to fresh air; if necessary, apply artificial respiration and/or administer oxygen. INGESTION: have victim drink water and induce vomiting; repeat three times; then give 1 tablespoon epsom salts in water. EYES: flush thoroughly with water. SKIN: wash thoroughly with soap and warm water. 5.4 Threshold Limit Value: 50 ppm 5.5 Short Term Inhalation Limit: 200 ppm for 30 min. 5.6 Toxicity by Ingestion: Grade 3; LD₅₀ = 50 to 500 mg/kg 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 50 ppm 5.11 IDLH Value: 1,000 ppm</p>	
<p>2. LABEL 2.1 Category: None 2.2 Class: Not pertinent</p>	<p>4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Chloroform-like; ethereal</p>

<p>6. FIRE HAZARDS 6.1 Flash Point: 90°F C.C.; practically nonflammable 6.2 Flammable Limits in Air: 8.0%-10.5% 6.3 Fire Extinguishing Agents: Water fog 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion: Products: Toxic and irritating gases are produced in fire situations. 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: 770°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: Not pertinent 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available</p>	<p>10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X-Y</p>
<p>7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 36</p>	<p>11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: ORM-A 11.2 NAS Hazard Rating for Bulk Water Transportation: Category Rating Fire _____ 1 Health _____ 1 Vapor Irritant _____ 1 Liquid or Solid Irritant _____ 1 Poisons _____ 2 Water Pollution _____ 1 Human Toxicity _____ 1 Aquatic Toxicity _____ 2 Aesthetic Effect _____ 2 Reactivity _____ 1 Other Chemicals _____ 1 Water _____ 0 Self Reaction _____ 1 11.3 NFPA Hazard Classification: Category Classification Health Hazard (Blue) _____ 2 Flammability (Red) _____ 1 Reactivity (Yellow) _____ 0</p>
<p>8. WATER POLLUTION 8.1 Aquatic Toxicity: 880 mg/l/40 hr/daphnia/kill/fresh water 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None</p>	<p>12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 131.39 12.3 Boiling Point at 1 atm: 189°F = 87°C = 360°K 12.4 Freezing Point: -123.5°F = -86.4°C = 186.8°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.46 at 20°C (liquid) 12.8 Liquid Surface Tension: 29.3 dynes/cm = 0.0293 N/m at 20°C 12.9 Liquid Water Interfacial Tension: 34.5 dynes/cm = 0.0345 N/m at 24°C 12.10 Vapor (Gas) Specific Gravity: 4.5 12.11 Ratio of Specific Heats of Vapor (Gas): 1.116 12.12 Latent Heat of Vaporization: 103 Btu/lb = 57.2 cal/g = 2.4 X 10⁵ J/kg 12.13 Heat of Combustion: Not pertinent 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: Data not available 12.18 Limiting Value: Data not available 12.19 Reid Vapor Pressure: 2.5 psi</p>
<p>9. SHIPPING INFORMATION 9.1 Grades of Purity: Technical dry cleaning; degreasing; extraction 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Pressure-vacuum</p>	<p>NOTES</p>

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
0	94.669	0	.220		N O T P E R T I N E N T	15	.800
5	94.410	10	.221			20	.775
10	94.150	20	.223			25	.750
15	93.889	30	.225			30	.727
20	93.629	40	.226			35	.705
25	93.370	50	.228			40	.684
30	93.110	60	.230			45	.664
35	92.849	70	.231			50	.645
40	92.589	80	.233			55	.627
45	92.330	90	.235			60	.610
50	92.070	100	.236			65	.593
55	91.809	110	.238			70	.577
60	91.549	120	.240			75	.562
65	91.290	130	.241			80	.548
70	91.030	140	.243			85	.534
75	90.770	150	.245			90	.521
80	90.509	160	.246			95	.508
85	90.250	170	.248			100	.496
90	89.990					105	.485
95	89.730					110	.474
100	89.469					115	.463
105	89.209					120	.453
110	88.950						
115	88.690						
120	88.429						
125	88.169						

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
77.02	.110	40	.508	40	.01245	0	.136
		50	.678	50	.01628	25	.139
		60	.894	60	.02105	50	.143
		70	1.166	70	.02695	75	.146
		80	1.507	80	.03418	100	.149
		90	1.929	90	.04296	125	.152
		100	2.448	100	.05354	150	.155
		110	3.081	110	.06619	175	.157
		120	3.846	120	.08120	200	.160
		130	4.765	130	.09891	225	.162
		140	5.862	140	.11960	250	.165
		150	7.163	150	.14380	275	.167
		160	8.695	160	.17180	300	.169
		170	10.490	170	.20390	325	.172
		180	12.580	180	.24080	350	.174
		190	15.010	190	.28280	375	.176
		200	17.810	200	.33040	400	.177
		210	21.020	210	.38420	425	.179
						450	.181
						475	.182
						500	.184
						525	.185
						550	.186
						575	.187
						600	.188

Common Synonyms Chloroethylene VCL Vinyl C Monomer VCM	Gas	Colorless	Sweet odor
Stop discharge if possible. Keep people away. Shut off ignition sources and call fire department. Stay upwind and use water spray to "knock down" vapor. Evacuate area in case of large discharge. Avoid contact with liquid and vapor. Notify local health and pollution control agencies.			
Fire	FLAMMABLE. POISONOUS GAS IS PRODUCED IN FIRE. Flashback along vapor trail may occur. May explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Cool exposed containers and protect men effecting shut-off with water. Stop flow of gas if possible. Let fire burn. Extinguish small fires with dry chemical.		
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose, and throat. If inhaled, will cause dizziness or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Will cause frostbite. Flush affected areas with plenty of water. DO NOT RUB AFFECTED AREAS.		
Water Pollution	Not harmful to aquatic life.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area		2. LABEL 2.1 Category: Flammable gas 2.2 Class: 2	
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Vinyl halides 3.2 Formula: CH ₂ =CHCl 3.3 IMO/UN Designation: 2.0/1086 3.4 DOT ID No.: 1086 3.5 CAS Registry No.: 75-01-4		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquefied compressed gas 4.2 Color: Colorless 4.3 Odor: Pleasant, sweet	
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Rubber gloves and shoes; gas-tight goggles; organic vapor canister or self-contained breathing apparatus. 5.2 Symptoms Following Exposure: INHALATION: high concentrations cause dizziness, anesthesia, lung irritation. SKIN: may cause frostbite; phenol inhibitor may be absorbed through skin if large amounts of liquid evaporate. 5.3 Treatment of Exposure: INHALATION: remove patient to fresh air and keep him quiet and warm; call a doctor; give artificial respiration if breathing stops. EYES AND SKIN: flush with plenty of water for at least 15 min.; for eyes, get medical attention; remove contaminated clothing. 5.4 Threshold Limit Value: 5 ppm 5.5 Short Term Inhalation Limit: 500 ppm for 5 min. 5.6 Toxicity by Ingestion: Not pertinent 5.7 Lethal Toxicity: Chronic exposure may cause liver damage. 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If soiled on clothing and allowed to remain, may cause smarting and reddening of skin. May cause frostbite. 5.10 Odor Threshold: 250 ppm 5.11 IDLH Value: Data not available			

6. FIRE HAZARDS 6.1 Flash Point: -110°F O.C. 6.2 Flammable Limits in Air: 4%-26% 6.3 Fire Extinguishing Agents: For small fires use dry chemical or carbon dioxide. For large fires stop flow of gas. Cool exposed containers with water. 6.4 Fire Extinguishing Agents Not to be Used: Not pertinent 6.5 Special Hazards of Combustion Products: Forms highly toxic combustion products such as hydrogen chloride, phosgenic, and carbon monoxide. 6.6 Behavior in Fire: Container may explode in fire. Gas is heavier than air and may travel considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 882°F 6.8 Electrical Hazard: Class I, Group D 6.9 Burning Rate: 4.3 mm/min. (Continued)	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-B-C-D-E-F-G-Z																																				
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity With Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Polymerizes in presence of air, sunlight, or heat unless stabilized by inhibitors. 7.6 Inhibitor of Polymerization: Not normally used except when high temperatures are expected. Then 40-100 ppm of phenol used. 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 35	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Flammable gas 11.2 NAS Hazard Rating for Bulk Water Transportation <table> <thead> <tr> <th>Category</th><th>Rating</th></tr> </thead> <tbody> <tr> <td>Fire</td><td>4</td></tr> <tr> <td>Health</td><td></td></tr> <tr> <td> Vapor Irritant</td><td>2</td></tr> <tr> <td> Liquid or Solid Irritant</td><td>1</td></tr> <tr> <td>Poisons</td><td>2</td></tr> <tr> <td>Water Pollution</td><td></td></tr> <tr> <td> Human Toxicity</td><td>0</td></tr> <tr> <td> Aquatic Toxicity</td><td>0</td></tr> <tr> <td> Aesthetic Effect</td><td>0</td></tr> <tr> <td>Reactivity</td><td></td></tr> <tr> <td> Other Chemicals</td><td>2</td></tr> <tr> <td> Water</td><td>0</td></tr> <tr> <td> Self Reaction</td><td>2</td></tr> </tbody> </table> 11.3 NFPA Hazard Classification <table> <thead> <tr> <th>Category</th><th>Classification</th></tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td><td>2</td></tr> <tr> <td>Flammability (Red)</td><td>4</td></tr> <tr> <td>Reactivity (Yellow)</td><td>1</td></tr> </tbody> </table>	Category	Rating	Fire	4	Health		Vapor Irritant	2	Liquid or Solid Irritant	1	Poisons	2	Water Pollution		Human Toxicity	0	Aquatic Toxicity	0	Aesthetic Effect	0	Reactivity		Other Chemicals	2	Water	0	Self Reaction	2	Category	Classification	Health Hazard (Blue)	2	Flammability (Red)	4	Reactivity (Yellow)	1
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8. WATER POLLUTION 8.1 Aquatic Toxicity: None 8.2 Waterfowl Toxicity: None 8.3 Biological Oxygen Demand (BOD): None 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Gas 12.2 Molecular Weight: 62.50 12.3 Boiling Point at 1 atm: $7.2^{\circ}\text{F} = 13.8^{\circ}\text{C} = 259.4^{\circ}\text{K}$ 12.4 Freezing Point: $-244.8^{\circ}\text{F} = -153.8^{\circ}\text{C} = -119.4^{\circ}\text{K}$ 12.5 Critical Temperature: $317.1^{\circ}\text{F} = 158.4^{\circ}\text{C} = 431.6^{\circ}\text{K}$ 12.6 Critical Pressure: 775 psia = 52.7 atm = 5.34 MN/m ² 12.7 Specific Gravity: 0.969 at -13°C (liquid) 12.8 Liquid Surface Tension: 16.0 dynes/cm = 0.0160 N/m at 25°C 12.9 Liquid Water Interfacial Tension: (est.) 30 dynes/cm = 0.03 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: 2.2 12.11 Ratio of Specific Heats of Vapor (Gas): 1.186 12.12 Latent Heat of Vaporization: 160 Btu/lb = 88 cal/g = $3.7 \times 10^4 \text{ J/kg}$ 12.13 Heat of Combustion: -8136 Btu/lb = $-4520 \text{ cal/g} = -189.1 \times 10^3 \text{ J/kg}$ 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: -729 Btu/lb = $-405 \text{ cal/g} = 16.9 \times 10^3 \text{ J/kg}$ 12.25 Heat of Fusion: 18.14 cal/g 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 75 psia																																				
9. SHIPPING INFORMATION 9.1 Grades of Purity: Commercial or technical 99+ % 9.2 Storage Temperature: Under pressure; ambient At atm. pressure; low 9.3 Inert Atmosphere: No requirement 9.4 Venting: Under pressure; safety relief At atm. pressure; pressure-vacuum																																					
6. FIRE HAZARDS (Continued) 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: 5.490 (Est.) 6.12 Flame Temperature: Data not available																																					

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
0	61.000	-30	.259		N O T P E R T I N E N T	-10	.287
5	60.710	-20	.265			-5	.281
		-10	.272			0	.276
		0	.279			5	.271

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
68.02	.600	-50	3.384	-50	.04810	0	.185
		-40	4.501	-40	.06245	25	.192
		-30	5.908	-30	.08005	50	.198
		-20	7.658	-20	.10140	75	.205
		-10	9.814	-10	.12710	100	.211
		0	12.440	0	.15760	125	.217
		10	15.610	10	.19360	150	.224
		20	19.410	20	.23560	175	.230
		30	23.920	30	.28440	200	.235
		40	29.220	40	.34050	225	.241
		50	35.430	50	.40470	250	.247
		60	42.630	60	.47760	275	.252
		70	50.940	70	.56000	300	.257
		80	60.480	80	.65250	325	.263
		90	71.349	90	.75570	350	.268
		100	83.669	100	.87050	375	.273
		110	97.580	110	.99740	400	.277
		120	113.200	120	1.13700	425	.282
						450	.286
						475	.291
						500	.295
						525	.299
						550	.303
						575	.307
						600	.311

VINYLDENE CHLORIDE (1,1-DCE)

VCI

Common Synonyms 1, 1-Dichloroethylene unarm-Dichloroethylene	Watery liquid Sinks in water. Flammable, irritating vapor is produced. Boiling point is 89°F.	Colorless	Sweet odor
Avoid contact with liquid and vapor. Keep people away. Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves). Shut off ignition sources and call fire department. Stop discharge if possible. Stay down and use water spray to "knock down" vapor. Evacuate area in case of large discharge. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire	FLAMMABLE. POISONOUS GAS IS PRODUCED IN FIRE. Containers may explode in fire. Flashback along vapor trail may occur. Vapor may explode if ignited in an enclosed area. Wear self-contained breathing apparatus. Combat fires from safe distance or protected location. Extinguish with dry chemical, foam, or carbon dioxide. Cool exposed containers with water.		
Exposure	CALL FOR MEDICAL AID. VAPOR Irritating to eyes, nose, and throat. If inhaled, will cause dizziness or difficult breathing. Move to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. LIQUID Will burn skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.		
Water Pollution	Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and welfare officials. Notify operators of nearby water intakes.		
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Issue warning-high flammability Evacuate area.		2. LABEL 2.1 Category: Flammable liquid 2.2 Class: 3	
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Vinyl halides 3.2 Formula: CH ₂ =CCl ₂ 3.3 IMO/UN Designation: 3.1/1303 3.4 DOT ID No.: 1303 3.5 CAS Registry No.: 75-35-4		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Sweet, like carbon tetrachloride or chloroform	
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; rubber gloves and boots. 5.2 Symptoms Following Exposure: Vapor can cause dizziness and drunkenness; high levels cause anesthesia. Liquid irritates eyes and skin. 5.3 Treatment of Exposure: INHALATION: If any illness develops, remove person to fresh air promptly, keep warm and quiet, and get medical attention; if breathing stops, start artificial respiration. INGESTION: not likely a problem; no known antidote; treat symptomatically. EYES OR SKIN: flush with plenty of water for at least 15 min; get medical attention for eyes; remove contaminated clothing and wash before reuse. 5.4 Threshold Limit Value: 10 ppm 5.5 Short Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 3; Oral LD ₅₀ = 24 hr = 84 mg/kg (adrenalecclomized rat) 5.7 Lethal Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure. 5.10 Odor Threshold: Data not available 5.11 IDLH Value: Data not available			

6. FIRE HAZARDS 6.1 Flash Point 0°F O.C. 6.2 Flammable Limits in Air: 7.3%-16.0% 6.3 Fire Extinguishing Agents: Foam, carbon dioxide, dry chemical 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective. 6.5 Special Hazards of Combustion: Products: Toxic hydrogen chloride and phosgene are generated in fire. 6.6 Behavior in Fire: May explode in fire due to polymerization. Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. 6.7 Ignition Temperature: 955-1031°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 2.7 mm/min. 6.10 Adiabatic Flame Temperature: Data not available (Continued)	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X-Y-Z																																				
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity With Common Materials: Copper and aluminum can cause polymerization. 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerization: Can occur if exposed to sunlight, air, copper, aluminum, heat. 7.6 Inhibitor of Polymerization: 200 ppm methyl ether of hydroquinone; 0.8-0.8% phenol 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 35	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Flammable liquid 11.2 NAS Hazard Rating for Bulk Water Transportation: <table> <tr> <th>Category</th><th>Rating</th></tr> <tr> <td>Fire</td><td>3</td></tr> <tr> <td>Health</td><td></td></tr> <tr> <td>Vapor Irritant</td><td>2</td></tr> <tr> <td>Liquid or Solid Irritant</td><td>2</td></tr> <tr> <td>Poisons</td><td>3</td></tr> <tr> <td>Water Pollution</td><td></td></tr> <tr> <td>Human Toxicity</td><td>0</td></tr> <tr> <td>Aquatic Toxicity</td><td>2</td></tr> <tr> <td>Aesthetic Effect</td><td>2</td></tr> <tr> <td>Reactivity</td><td></td></tr> <tr> <td>Other Chemicals</td><td>2</td></tr> <tr> <td>Water</td><td>0</td></tr> <tr> <td>Self Reaction</td><td>3</td></tr> </table> 11.3 NFPA Hazard Classifications: <table> <tr> <th>Category</th><th>Classification</th></tr> <tr> <td>Health Hazard (Blue)</td><td>1</td></tr> <tr> <td>Flammability (Red)</td><td>4</td></tr> <tr> <td>Reactivity (Yellow)</td><td>2</td></tr> </table>	Category	Rating	Fire	3	Health		Vapor Irritant	2	Liquid or Solid Irritant	2	Poisons	3	Water Pollution		Human Toxicity	0	Aquatic Toxicity	2	Aesthetic Effect	2	Reactivity		Other Chemicals	2	Water	0	Self Reaction	3	Category	Classification	Health Hazard (Blue)	1	Flammability (Red)	4	Reactivity (Yellow)	2
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8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 96.95 12.3 Boiling Point at 1 atm: 58.9°F = 31.6°C = 304.8°K 12.4 Freezing Point: -187.6°F = 122.0°C = 151.2°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.21 at 20°C (liquid) 12.8 Liquid Surface Tension: 24 dynes/cm = 0.024 N/m at 15°C 12.9 Liquid Water Interfacial Tension: 37 dynes/cm = 0.037 N/m at 22.7°C 12.10 Vapor (Gas) Specific Gravity: 3.3 12.11 Ratio of Specific Heats of Vapor (Gas): Data not available 12.12 Latent Heat of Vaporization: 130 Btu/lb = 72 cal/g = 3.0 X 10 ⁴ J/kg 12.13 Heat of Combustion: -4860 Btu/lb = -2700 cal/g = -113.0 X 10 ⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: -333 Btu/lb = -185 cal/g = -7.75 X 10 ⁴ J/kg 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: 18.3 psia																																				
9. SHIPPING INFORMATION 9.1 Grades of Purity: 99% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: Packed 9.4 Venting: Pressure-vacuum 6. FIRE HAZARDS (Continued) 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available																																					

VCI	VINYLDENE CHLORIDE (1,1-DCE)
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12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
-20	81.450	0	.262		N O T P E R T I N E N T	-20	.478
-15	81.129	10	.268			-15	.466
-10	80.799	20	.273			-10	.455
-5	80.469	30	.279			-5	.443
0	80.139	40	.284			0	.433
5	79.809	50	.290			5	.423
10	79.480	60	.295			10	.413
15	79.150	70	.301			15	.404
20	78.820	80	.307			20	.395
25	78.490					25	.387
30	78.160					30	.378
35	77.830					35	.371
40	77.500					40	.363
45	77.169					45	.356
50	76.839					50	.349
55	76.509					55	.342
60	76.179					60	.336
65	75.849					65	.330
70	75.520					70	.324
75	75.200					75	.318
80	74.870					80	.313
85	74.540					85	.307

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F (estimate)
68.02	.500	40	5.115	40	.09246	100	.169
		50	6.473	50	.11470	120	.172
		60	8.108	60	.14090	140	.175
		70	10.060	70	.17150	160	.178
		80	12.360	80	.20690	180	.181
		90	15.070	90	.24760	200	.184
		100	18.220	100	.29410	220	.188
		110	21.870	110	.34670	240	.189
		120	26.060	120	.40600	260	.192
		130	30.850	130	.47250	280	.194
		140	36.290	140	.54650	300	.197
		150	42.430	150	.62860	320	.199
		160	49.340	160	.71920	340	.202
		170	57.070	170	.81860	360	.204
		180	65.680	180	.92720	380	.206
		190	75.200	190	1.04600	400	.209
		200	85.750	200	1.17400	420	.211
		210	97.330	210	1.31300	440	.213
						460	.215
						480	.217
						500	.219
						520	.221
						540	.223
						560	.225
						580	.227
						600	.229